INTERAVIA

WORLD REVIEW OF AVIATION AND ASTRONAUTICS

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Pillars of World Air Transport

VOLUME XIV

No 10/1959

In more than 24,000,000 miles of scheduled operations, the Boeing 707 has averaged a load factor of 95% to become the most popular airliner in the history of aviation.

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Volume XIV

INTERAVIA

October 1959

WORLD REVIEW OF AVIATION AND ASTRONAUTICS

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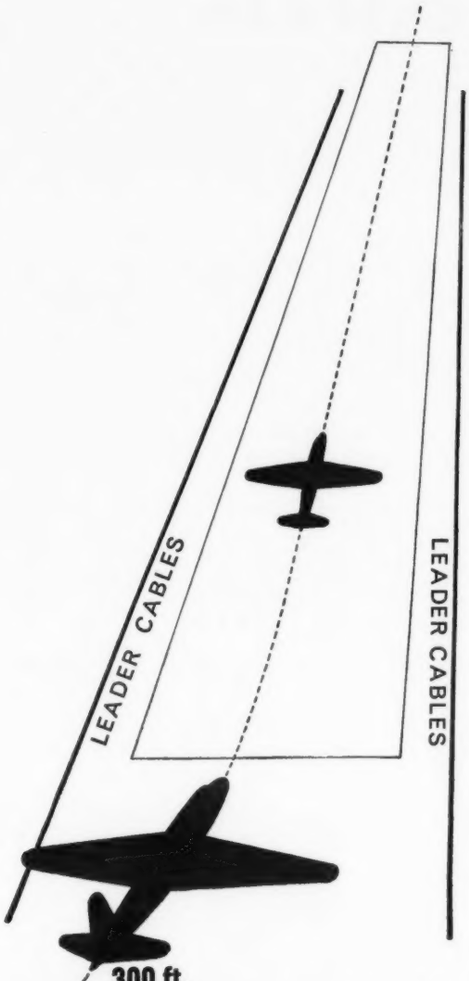

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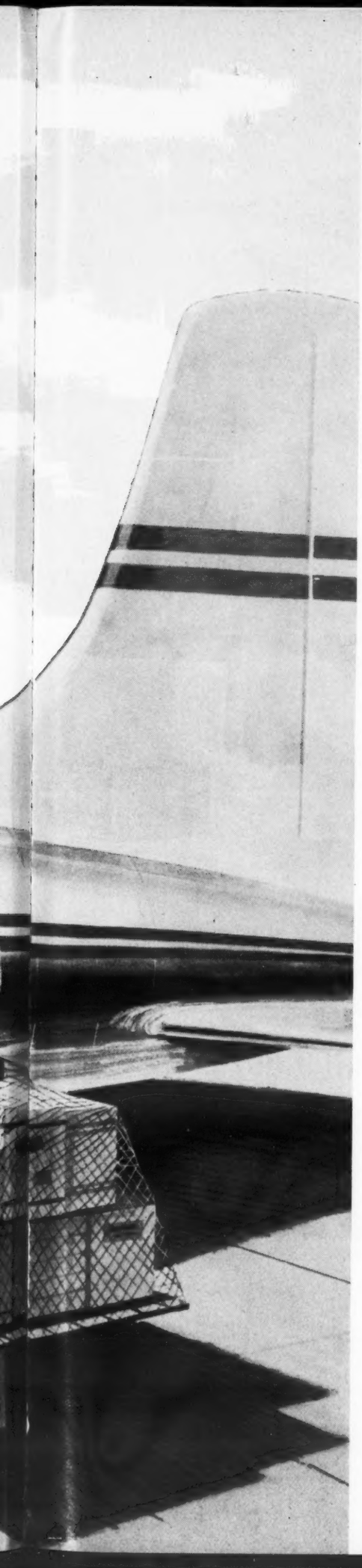

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Extremely simple to maintain, economical to operate, the 204 is designed to operate 1000 hours between major inspections ; no part requires more than 30 minutes to replace. The helicopter is low in silhouette, fast and maneuverable ; it performs with excellence both at high altitudes and in hot weather and carries all-weather flight instruments.

This new Bell, designed to meet precise standards of the U.S. Army use and designated the HU-1A, is now in full production for the military. Soon it will be available to governments and industries throughout the Free World. Look to Bell—leader in the field—for the most reliable helicopters ever built.

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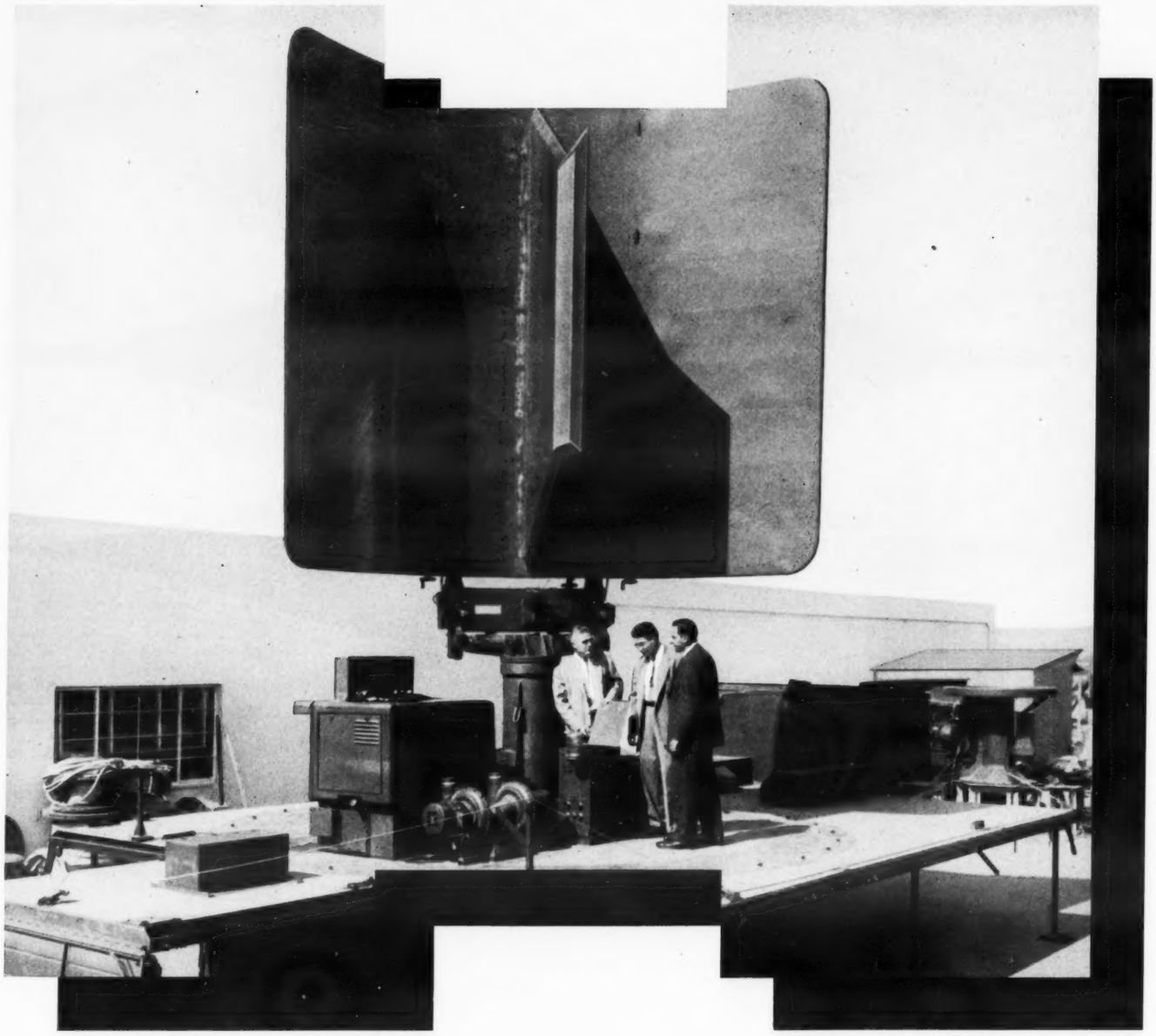


all directions at once

A radical new method for defense surveillance, Hughes Aircraft Company's three-dimensional radar, positions radar beams in space by electronic rather than mechanical means. Providing three-dimensional target data from a single antenna, transmitter, and receiving channel, it is probably the most important advance in the art since radar itself was conceived.

This Hughes development uses a radar antenna whose pointing direction is made sensitive to the frequency of the electromagnetic energy applied to the antenna. This frequency sensitivity results in the radar beam being radiated from the antenna at different angles, depending on the frequency of the energy supplied. With the supply of a succession of frequencies, the antenna beam can be moved through a succession of positions. Utilizing this advanced technique, range, bearing and altitude can be detected...on a single antenna...with significant reduction in mechanical equipment requirements.

Combined with compact, high-speed Hughes data processors, Hughes three-dimensional radar provides a completely self-sufficient, mobile radar defense system.

This vital new defense system is but one example of Hughes capability. Some of Hughes current areas of research and development include satellite interception systems, meteor communications, space ferry systems, electronics in oceanography, nuclear electronics, ballistic missiles, global surveillance satellite systems.

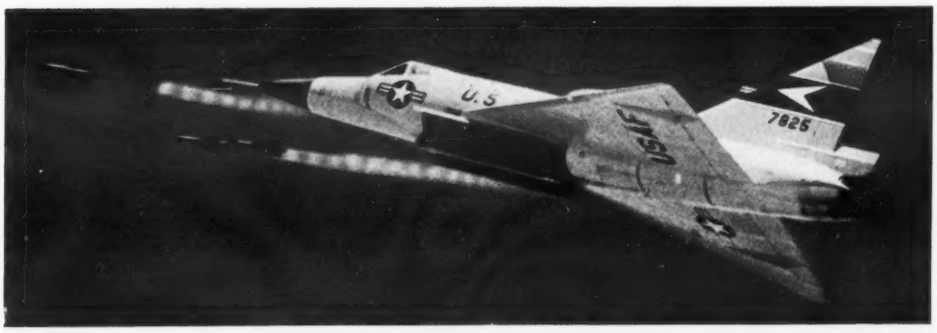
The Hughes Products engineering team makes electronics useful in solving industrial problems. It is a world leader in the production of high-reliability diodes and transistors. Other products include advanced electron tubes, instruments, automatic industrial systems and controls.

Throughout the entire Hughes organization, special emphasis is put on building the highest standards of reliability into every system. This is done to assure maximum utilization even under the most severe operating conditions.

Advanced concepts...reliable hardware...continuing field services...are the factors which have made Hughes one of the world's most respected electronics producers.

For further information please write to Hughes International, a division of Hughes Aircraft Company, Culver City, California, U.S.A.

Falcon missiles *have been an important factor in establishing Hughes as a leader in advanced airborne electronics. Falcon missiles are equipped with either infrared or radar guidance systems.*



The Hughes Airborne Armament Control System *in the Convair F-102 interceptor automatically locates the target at long range...flies the correct attack course...fires armament or notifies pilot when to fire.*

HUGHES INTERNATIONAL
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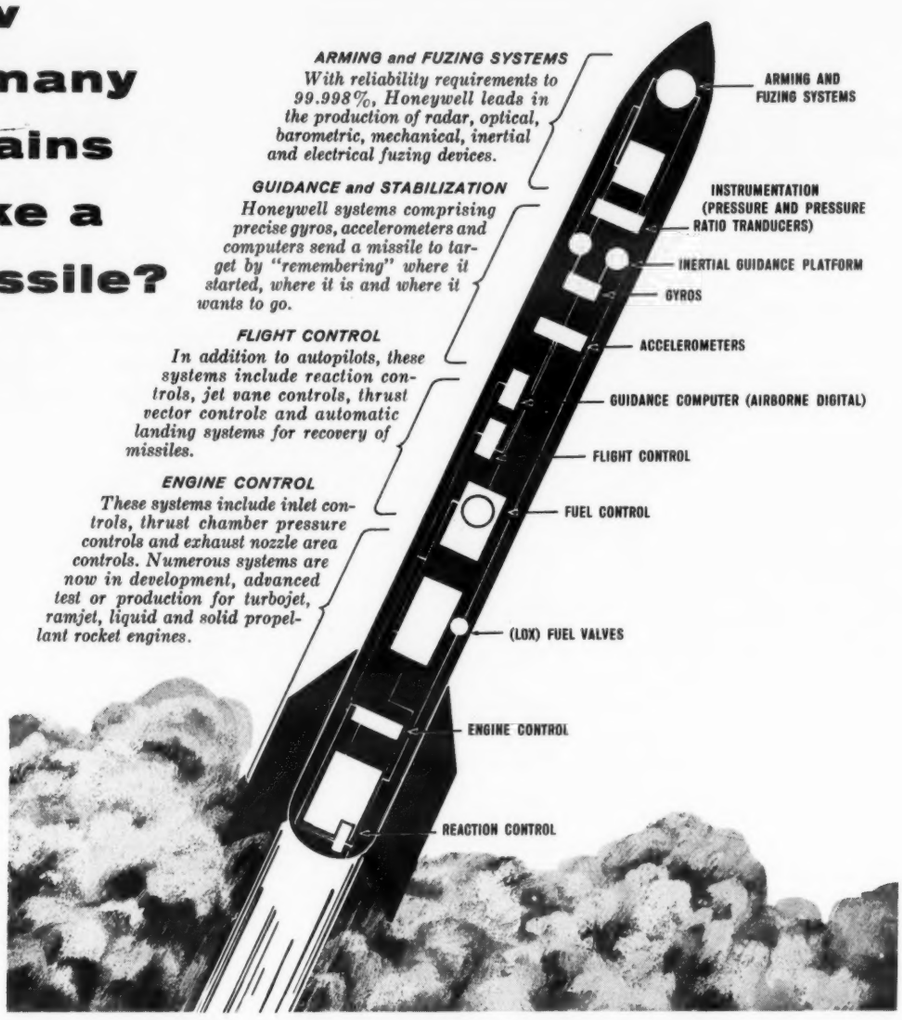
How many brains make a missile?


ARMING and FUZING SYSTEMS
With reliability requirements to 99.998%, Honeywell leads in the production of radar, optical, barometric, mechanical, inertial and electrical fuzing devices.
GUIDANCE and STABILIZATION
Honeywell systems comprising precise gyros, accelerometers and computers send a missile to target by "remembering" where it started, where it is and where it wants to go.
FLIGHT CONTROL
In addition to autopilots, these systems include reaction controls, jet vane controls, thrust vector controls and automatic landing systems for recovery of missiles.
ENGINE CONTROL
These systems include inlet controls, thrust chamber pressure controls and exhaust nozzle area controls. Numerous systems are now in development, advanced test or production for turbojet, ramjet, liquid and solid propellant rocket engines.
ARMING AND FUZING SYSTEMS
INSTRUMENTATION (PRESSURE AND PRESSURE RATIO TRANDUCERS)
INERTIAL GUIDANCE PLATFORM
GYROS
ACCELEROMETERS
GUIDANCE COMPUTER (AIRBORNE DIGITAL)
FLIGHT CONTROL
FUEL CONTROL
(LOX) FUEL VALVES
ENGINE CONTROL
REACTION CONTROL

Control systems are the brains that guide, control and explode missiles. Honeywell can build any of those integral control systems or sub-systems.

Honeywell is now developing and producing systems, sub-systems and components for the following missiles; Sidewinder, Honest John, Asroc, Corporal, Thor, Redstone, Wagtail, LaCrosse, Sergeant, Little John, Titan, Falcon, Vanguard and many classified applications. This broad experience in missiles, as well as a solid background in rockets and aircraft systems, makes Honeywell the logical company to aid you in your airborne control problems.

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These qualities, plus the turboprop economy of the four Rolls-Royce Tyne R Ty.12 engines, make the Britannic a formidable contender for the air freight market of the future.

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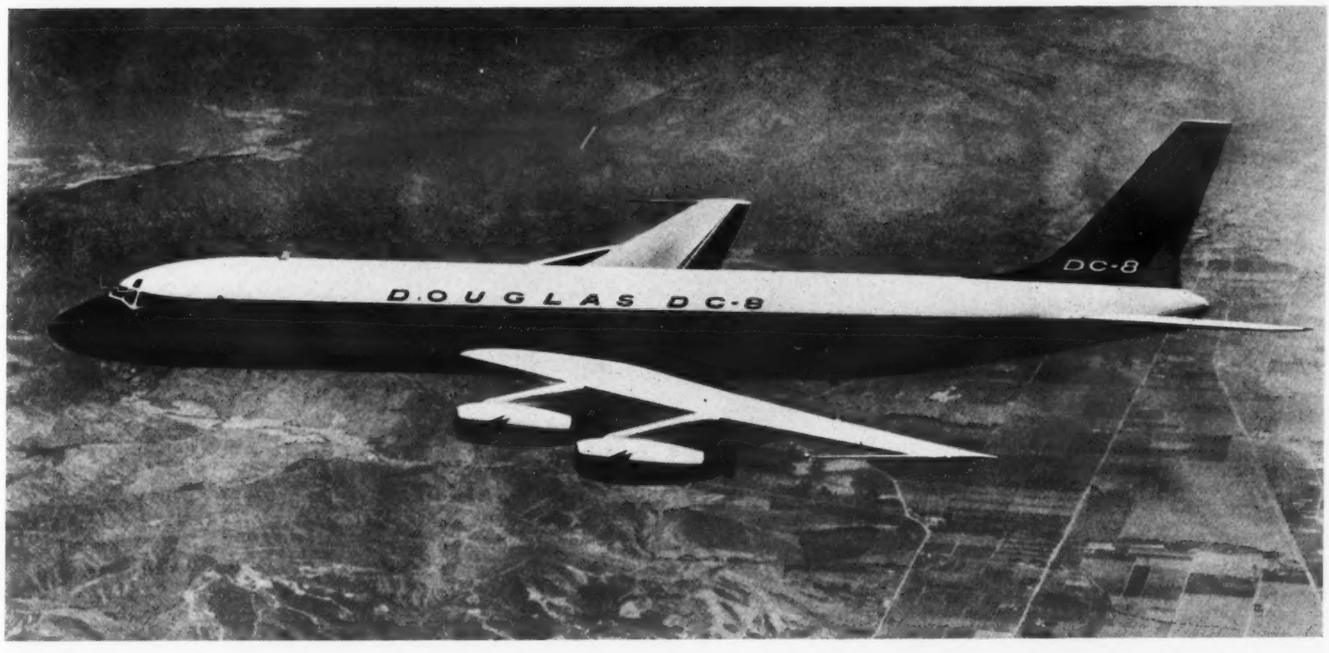
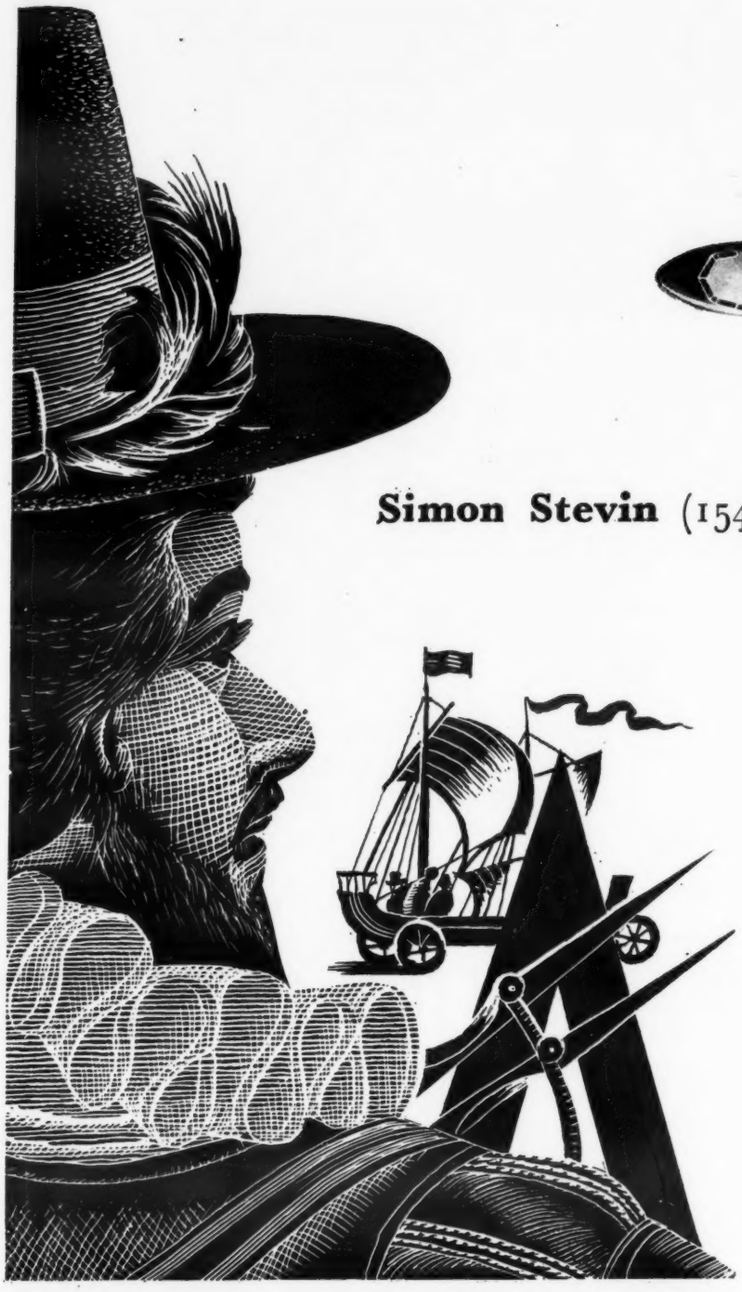
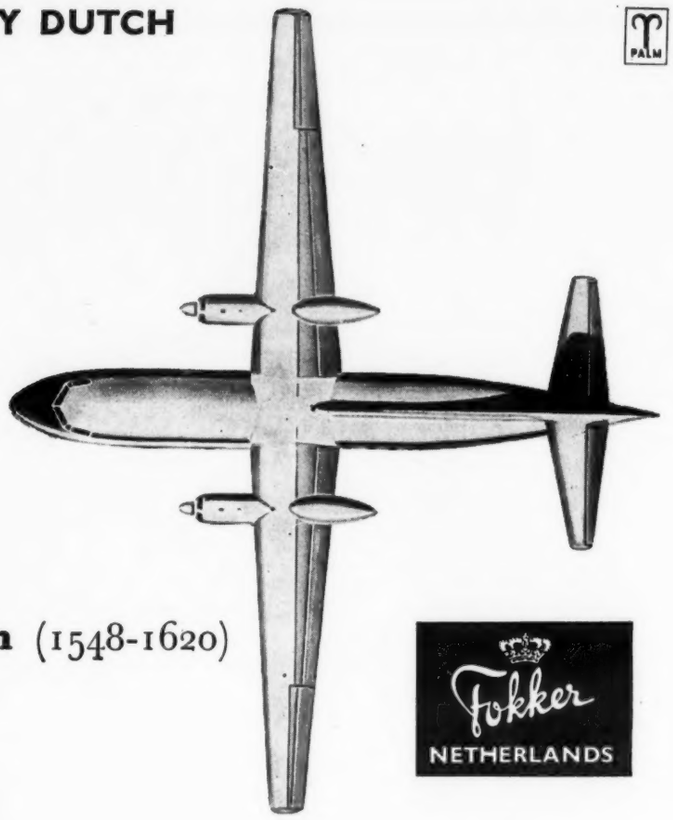


PIONEERING: TRADITIONALLY DUTCH



Simon Stevin (1548-1620)



Fokker NETHERLANDS

Many Dutch mathematicians combined professional skill with a pioneering spirit that led to countless inventions. Famous for many such inventions, Simon Stevin was praised most for a carriage with sails (precursor of automotion). The same spirit is still alive in the Netherlands. Fine evidence is the Fokker F. 27 "Friendship" combining economy with outstanding reliability.

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INTERAVIA AIR LETTER reports...

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Trans World Airlines will inaugurate a non-stop Boeing 707-331 jet service between New York and London (extended to Frankfurt) on November 23rd with an initial frequency of three flights weekly. Eastbound services will depart Idlewild each Monday, Wednesday and Friday at 19:30 arriving London 06:55, departing London 08:00, arriving Frankfurt 10:10 (all local times). Westbound services depart Frankfurt each Tuesday, Thursday and Saturday at 15:45, London 16:00/17:00, arriving Idlewild 19:30. Effective December 3rd, TWA will operate non-stop New York-Paris-Rome. The Boeing 707-331 departs Idlewild each Tuesday, Thursday and Saturday, Rome Wednesday, Friday and Sunday. The aircraft will have a 32 first class and 102 economy class passenger layout.

●

Malcolm A. MacIntyre, who resigned as Under Secretary of the USAF in July, has been elected President, a Director and Chief Executive Officer of Eastern Air Lines, effective October 1st, 1959. MacIntyre takes over as President from Captain Eddie Rickenbacker, who continues as Chairman of the Board heading the seven-man Executive Committee dealing with major policy matters. Thomas F. Armstrong will take over the newly-created post of Executive Vice President. — Eastern Air Lines currently operates the United States' largest airline fleet, comprising 233 airliners headed by the Lockheed *Electra*; EAL has 16 Douglas DC-8 on order, the first scheduled for delivery in November this year.

●

At Frankfurt Rhine/Main Airport the new extension to the main runway (now 11,810 feet) was officially brought into service on September 5th, when a Pan American World Airways Boeing 707 aircraft visited the airport. From October 25th PAA will operate a daily Boeing 707-321 intercontinental service to London and New York from Frankfurt. The service departs at 16:45 hours, landing at Idlewild at 21:10 hours local time.

●

All Deutsche Lufthansa's pilots will be of German nationality by the spring of 1960. Progress at the carrier's Bremen school, says DLH Manager Hans M. Bongers, has been so good that Lufthansa's entire requirement (approx. 200 pilots) can be filled with German personnel, and the Trans World Airlines pilots on loan to DLH can return to their firm. Preparations for Boeing 707 pilot training are also in hand, and a flight simulator will come into operation at Hamburg in November; the jet conversion course requires 40 hours flying training, and over half can be performed on the simulator.

●

Alitalia has now finally decided on the Sud-Aviation SE.210 *Caravelle* as its medium-haul jet airliner. Four have already been ordered, with an option on a further four.

●

SAS Scandinavian Airlines System's Mechanics School at Stockholm-Arlanda Airport is to have a four-unit jet engine trainer built by Redifon in the U.K. The four units comprise the pilot's station, systems operator's station, instructor's panel, and a large console containing a cutaway model of a Pratt & Whitney JT-4 engine. The trainer is scheduled for installation in early 1960.

●

Executives of eleven European airlines participated in the Air Research Bureau's 26th Managers Meeting held in the middle of September at Hamburg. Lufthansa Manager Hans M. Bongers was in the chair. Chief item on the agenda was the question of air traffic research, and the meeting approved a research and experimental programme for 1960. The conference was also presented with the first edition of a new timetable produced for ARB and entitled "Airtime Quick Reference to European Air Travel", which will be on general sale in early November.

●

In the People's Republic of China, where civil aviation is still in its infancy, Peking today is nevertheless the centre of a 22,370-mile route network serving some 70 internal and foreign cities. International services extend to the Soviet Union, North Korea, Vietnam, Mongolia and Burma; inside China itself air transport now serves the most urgent long-range passenger routes and handles the more important express cargo. Passenger and freight figures have increased by 1,100 percent against 1950. China's civil aviation has a Special Flight Group which provides a direct service for industry and agriculture; the group's tasks include forestry work, geological and territorial surveys, pest control, seed sowing and crop spraying. The Government is pushing through a whole series of technical developments to improve air traffic control and the air services. The airport at Peking is being equipped with the most modern technical equipment, and a Civil Aviation School has been established to ensure a steady development of aviation and to provide a stream of young technicians for the industry.

●

The Douglas DC-8 made a test flight over the Atlantic to Amsterdam on September 4th. The aircraft left Long Beach, California, at 02:57 GMT and arrived at London Airport for a refuelling stop at 13:39 GMT, a flight time of 10 hours 42 minutes for the 5,823-mile journey. In Amsterdam the DC-8 was demonstrated to representatives of KLM Royal Dutch Airlines, the Netherlands Ministry of Civil Aviation and the press.

●

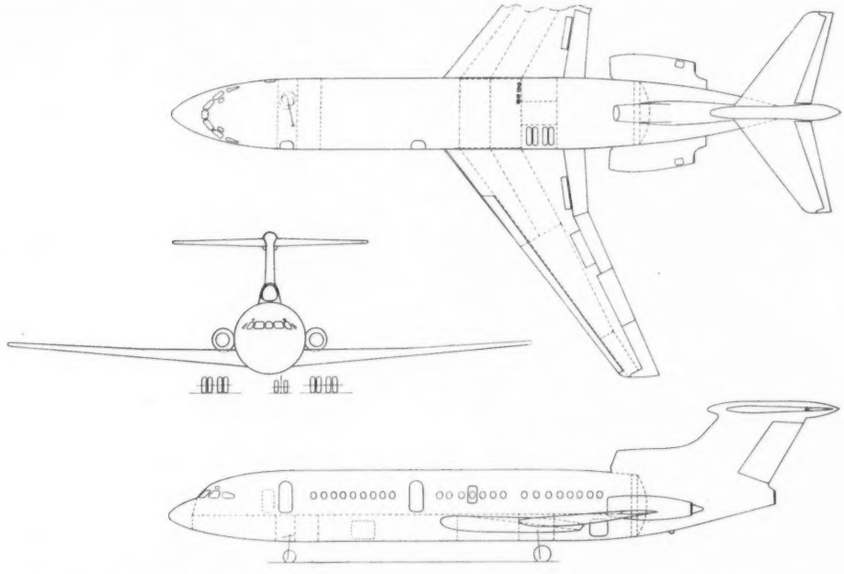
The first Lockheed C-130B Hercules production model has completed a 4,618-mile test flight from Hawaii to Georgia at an average speed of 350 m.p.h. The C-130B, a development of the C-130A, was designed to operate stages of 4,000 miles non-stop.

●

Lockheed Aircraft Corporation has developed a new light single-engine aircraft designed for utility service from short, rough landing strips; the aircraft will be built by Lockheed Azcarate Inc. in Mexico City. The prototype is nearing completion at Lockheed's Marietta, Georgia, plant and the first production model is expected to fly within twelve months. No details of the aircraft, which will be the first small civil aircraft to be built by Lockheed since the end of World War II, are yet available.

●

General Dynamics Corporation has announced the sale of $60 million 20-year promissory notes to the Prudential Insurance Company of America, at an interest rate of 5.5 percent per annum; proceeds of the loan will be used to augment G.D. working capital. (A similar loan of $75 million was negotiated with Prudential in September, 1958). General Dynamics Chairman Frank Pace, Jr., said that the two loans will satisfy the corporation's capital requirements for the foreseeable future and will permit it to go ahead with development and expansion plans. As at June 30th, 1959, General Dynamics reported an order backlog of approximately $2,500 million.



The Airco D.H.121 short- to medium-haul jet airliner (three Rolls-Royce RB.163, 10,000 lb thrust each). Wing span 89' 10"; gross weight 105,000 lb; max. speed 526 knots at 25,000 ft. Economical operating range 200 to 1,200 miles.

The list of United States aircraft industry firms with offices in Geneva continues to grow, and it is now reported that United Aircraft Export Corporation will also open a new office in this city. United Aircraft Export Corporation's main European Office will continue in London under the direction of Vice President Harvey Jolly, and the Geneva branch is designed to offer closer liaison with the other aircraft industry firms already represented there. Louis Robert Dooley will head the new office. — The Temco Export Corporation has set up a European office at Hermance, near Geneva, which will also be responsible for the Middle East. It is directed by Vice President Hiram R. Mallinson.

●

Hawker Siddeley Aviation has received an order from the British independent operator BKS Air Transport Ltd. for two Avro 748 medium-range turboprop aircraft, with an option on a further three. Delivery is scheduled for early 1961, and BKS will operate the Avro 748 as a DC-3 replacement on its scheduled passenger and freight services in the U.K. and to continental cities such as Basle, Rotterdam and Bergen. — Another British independent, Skyways Ltd., has given Hawker Siddeley a letter of intent on an order for an unspecified number of Avro 748s.

●

Bristol Aircraft has worked out designs for a series of light liaison and sports aircraft to be built largely of plastics. The designs have not yet been put into execution.

●

The development of Flugzeugbau Nord, in particular Weser Flugzeugbau GmbH and Hamburger Flugzeugbau GmbH, still continues to be uncertain. By March 1961 the Flugzeugbau Nord consortium will have phased out production of the 112 Nord Aviation 2501 *Noratlas* on order, and no extension of the 1956 contract is foreseen. The first *Noratlas* was completed in August 1958 and construction time is currently sixteen and a half months, to be decreased to thirteen months after the 76th aircraft is completed ; production rate is four aircraft per month. This group is still concerned in the Transall project for a medium-range military transport aircraft, but as it is unlikely that planning will have reached the stage where production work could follow on the *Noratlas* activity, NATO circles are mentioning the possibility that, as a solution, a number, say fifty, of Lockheed *Super Hercules* may be built under licence in West Germany. Such a proposal would guarantee the future of Germany's northern aircraft industry until further projects for airliners and helicopters materialize.

●

Ernst Heinkel Flugzeugbau GmbH, of Speyer, has increased its capital to DM 5.1 million. The management consists of Professor Dr.-Ing. Karl Thalau (Technical Manager), Hans Nürnberger (General Manager) and Kurt Lauser (Commercial Manager). Heinkel's development team is playing a major role in the work of the South German Development Group (Entwicklungsring Süd) set up by Heinkel, Messerschmitt and Bölkow, which is working on projects for a VTOL interceptor. The Heinkel firm itself is engaged in preliminary design work on the He 211, a twin-turboprop 22-passenger commercial airliner. In the production field Heinkel is constructing the Potez-Air Fouga CM.170R *Magister* under licence within the Flugzeug-Union Süd consortium ; seven to eight aircraft are rolled out each month, and the German-produced model costs approximately DM 580,000, including powerplant and undercarriage supplied from France. Heinkel is also developing a four-seat version of the *Magister* as a private venture. The *Magister* programme will be followed by production of the Lockheed F-104 and Fiat G.91 ; for this purpose two new partnerships have been founded—" Arbeitsgemeinschaft 104 " (Arge 104) comprising the firms of Heinkel, Messerschmitt, Dornier and Siebel (capital requirements about DM 10 million) and " Arbeitsgemeinschaft 91 " (Arge 91) comprising Heinkel, Messerschmitt and Dornier. Heinkel counts on full employment under these programmes for several years. Present number of employees is about 950.

●

Earle K. Brownridge has resigned as President and General Manager of Orenda Engines Ltd. ; no official reason has been given and his successor has not been named. J. H. May, Vice President Manufacturing, has been appointed acting General Manager. Brownridge's resignation is the ninth among the top executives of A. V. Roe Canada Ltd., and its subsidiaries, since cancellation of the Arrow programme last February. Brownridge was named President of Orenda only last May, following the resignation of Walter R. McLachlan.

Six U.S. airlines have received USAF contracts totalling $37 million for the transportation of military personnel and cargo. The carriers concerned are : Alaska Air Lines, Capitol, Hawaiian Airlines, Overseas National Airways, Seaboard & Western, and Slick Airways.

●

A Dornier Do 27 was recently demonstrated to the British Army in the U.K. ; the Army has a requirement for such a type, and has previously been studying the question of importing *Beavers* from Canada. The Do 27 would meet the British Army's requirements, and is low priced and immediately available. Blackburn Aircraft (the Blackburn Group Ltd.) has arranged to handle the Do 27 in the U.K. and would undertake any modifications or fitting of new equipment which might be required, as well as servicing etc. — The sale of a German aircraft to a British Service would represent the first step in real U.K.-European cooperation and would be the factual fulfilment of the British Government's recently stated policy of cooperation and interchange. If an order is in fact placed for the Do 27 it will have very far-reaching effects.

Workshop Briefs

The pre-production series of the Dassault Mirage III will be completed by the end of the year, and the first production aircraft (1×SNECMA Atar ; 1×SEPR rocket motor ; CSF Cyrano radar) will be rolled out in September, 1960. — Four *Etendard IV Ms* have made their maiden flights. November 15th is the roll-out date for *Etendard IV M* 03, on which the SNECMA Atar 8 jet engine (which powers the standard version of the *Etendard IV M*) will be replaced by a Rolls-Royce *Avon* to increase possibilities of sales to certain Commonwealth countries. This aircraft will also be experimentally equipped with blowing slots for boundary layer control.

●

The third Fouga CM.175 Zéphyr twin-jet trainer for the naval air arm will be rolled off Potez-Air Fouga's assembly line at Toulouse this month. From next month onwards the trainer will roll out at the rate of two per month to complete the order for 30 *Zéphyrs* for the training of carrier-borne aircraft pilots. — Production of the Fouga DM.170R *Magister*, powered like the *Zéphyr* with two Turboméca *Marboré II* jets, also continues, and the 230th aircraft was rolled out at Toulouse last week. Twenty-seven more will be delivered by the end of the year. In 1960 priority will be given to the 45 *Magisters* for Belgium, and it is likely that the 600 trainers of this type already ordered will be joined by a further number.

●

According to a communication from the British Ministry of Supply, the first Short SC.5 *Britannic* heavy freighter will be ready for flight testing early in 1962 and will be in service with RAF Transport Command by 1964. Short says that an attempt will be made to improve on these dates. — A Short *Britannic* sales group has been set up for home sales, overseas sales being handled by the sales organization of Bristol Aircraft Ltd. — The *Britannic*, the 3A version of which is being developed for the RAF, will be equipped with four Rolls-Royce *Tyne RTy.12*, each of 5,730 e.h.p., and will operate at a maximum gross weight of 218,000 lb.

For civil purposes the SC.5 could carry up to 249 passengers with economy class layout. Other potential tasks for the aircraft would be load-dropping, ambulance services, civil freight transport etc.

●

A new mark of the Turboméca Marboré jet engine, the *Marboré VI*, was on view for the first time at the Paris Air Show. The thrust of this version is 176 lb more than that of previous ones (total thrust 1056 lb). A Magister powered by two of these new *Marborés* is at present undergoing tests at the Istres Flight Test Centre.

●

The prototype of the Max Holste MH.250 Super Broussard recently completed the first phase of its tests at Rheims. Since it first flew on May 20th, the MH.250 has logged 103 flying hours and 117 landings. The tests have fully confirmed all forecasts, at times exceeding the contract specifications. The aircraft took off fully loaded with 20° flaps in 885 ft ; stalling speed with 45° flaps is 56 knots. — After its hundred-hour maintenance check the aircraft will continue its tests. — Max Holste has also begun building the MH-260 prototype, which will be identical with the production version and will have two Turboméca *Bastan* propeller turbines. It will begin testing in spring, 1960.

●

The KOVO foreign trade organization, of Prague, has recently brought onto the market the OPD 250 oscillograph, which is distinguished by its exceptionally long afterglow and is particularly suitable for observing slowly developing situations.

Photo credits : Front cover : Interavia files ; pp. 1204-1205 : Interavia files ; p. 1206 : JAL (8), Interavia files (1) ; pp. 1207-1211 : Air France (2), Lufthansa (4), PAA (4), KLM (1), BOAC (1), American Airlines (2), Air-India (2), Japan Air Lines (2), Swissair (1), Sabena (1) ; p. 1228 : author ; pp. 1234-1235 : author ; pp. 1236-1237 : Howard Levy (2), U.S. Army (4), manufacturers (7) ; pp. 1240-1241 : manufacturers ; pp. 1242-1243 : manufacturers ; pp. 1244-1245 : manufacturers ; p. 1246 : manufacturers ; pp. 1255-1256 : manufacturers ; pp. 1257-1259 : author ; pp. 1268-1270 : manufacturers (1), Interavia (2) ; pp. 1271-1275 : Interavia ; pp. 1276-1278 : USAF (1), BEA (1), manufacturers (11) ; pp. 1283-1285 : Office of Civil and Defense Mobilization (1), Interavia files (3) ; p. 1286 : manufacturers (2), Interavia (6).

SURVIVAL DEPENDS ON VERSATILITY

IN DEFENCE AGAINST AIR ATTACK AS IN NATURE

The story of evolution is the story of success, or failure, in versatility. Those animals that could adapt themselves to changing conditions flourished and survived. Those that were too set in their ways died out.

It is not only in Natural History that versatility is of critical importance. It is equally so in the field of defence against air attack. If we ever again have to defend ourselves against such attack, the one certain thing is that it would be planned to make things as difficult as possible for the defence. The less flexible our methods of defence the more easily they could be baffled.

VERSATILITY IN DEPLOYMENT A vital weapon for defence against air attack is the guided missile. Missile systems can either be permanently sited on fixed concrete emplacements, or, like the English Electric Thunderbird, be made fully mobile, moved across country in standard military vehicles, and redeployed in a few hours.

The important thing is that Thunderbird can also be used in a static role. It can be set up on a chosen site for as long as that site continues to be the most suitable one. But if the unexpected happens — and in war it always does — Thunderbird can be resited and in action again overnight. It is operationally flexible. Now in service with the Army, its inherent mobility allows quick changes of strategy, easy resiting of defence and provides the versatility which is of ever increasing importance to present and future air defence.

NEW DEVELOPMENTS Evolution is going on. Already the successor to Thunderbird has been under development for some considerable time. Employing advanced techniques and retaining its full mobility it will have, among other things, increased low level capability and increased range.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LIMITED · *GUIDED WEAPONS DIVISION* · LUTON · STEVENAGE WOOMERA

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

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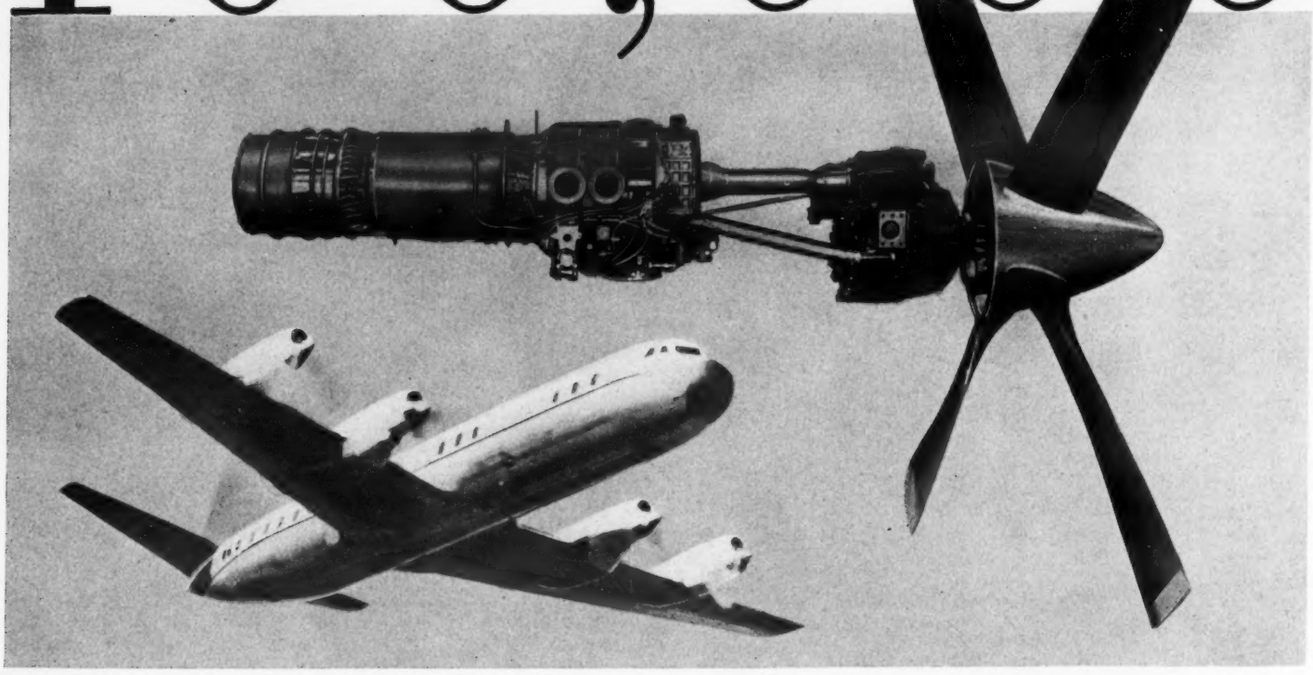
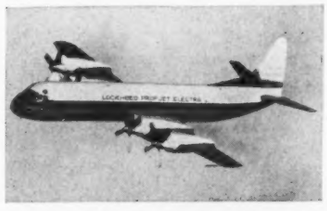


Flight Hours Per Month

Allison prop-jet power daily is proving its flight durability and dependability in airline service around the world. Flight experience is being accumulated in both military and commercial service at the rate of 100,000 hours a month with the rate increasing rapidly as new aircraft go into service.

Consisting of the matched team of Allison model 501 prop-jet engines and Aeroproducts 606 turbo-propellers, Allison prop-jet power is setting new standards of economical operations. Operators find its high power and good takeoff thrust enable higher payloads and reduced trip time. With constant engine propeller speed in flight, ample power for any requirement is available **instantly.** For **modern** prop-jet power, look to Allison prop-jet power.

Allison-powered C-130 military freighters have logged more than 750,000 hours.



Allison-powered Lockheed Electras are now in service with 10 of the world's leading airlines.

The Allison model 501-D13 engine is a logical choice for conversion of piston-powered aircraft to turbine power.

ALLISON PROP-JET POWER

Caravelle

is in service on the European network of AIR FRANCE

PARIS-MILAN : 1 hr 20 min flight
PARIS-ROME : 2 hr flight
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TOTAL SILENCE AT 500 MPH

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THE WORLD'S LONGEST ROUTE NETWORK

A FLEET OF 24 CARAVELLES WILL BE PROGRESSIVELY INTRODUCED ON THE WHOLE OF AIR FRANCE'S EUROPEAN NETWORK
CONSULT YOUR TRAVEL BUREAU OR THE NEAREST AIR FRANCE AGENCY. RESERVE YOUR SEAT IN TIME—TODAY

IN OPERATIONAL SERVICE

With the selection by West Germany and Canada of Lockheed's F-104 Starfighter, the services of the world's most thoroughly tested and efficient interceptor are made available to NATO defense forces.

In addition to its amazing multi-mission capability the F-104 has demonstrated the following advantages during more than one year's operational service with the USAF:

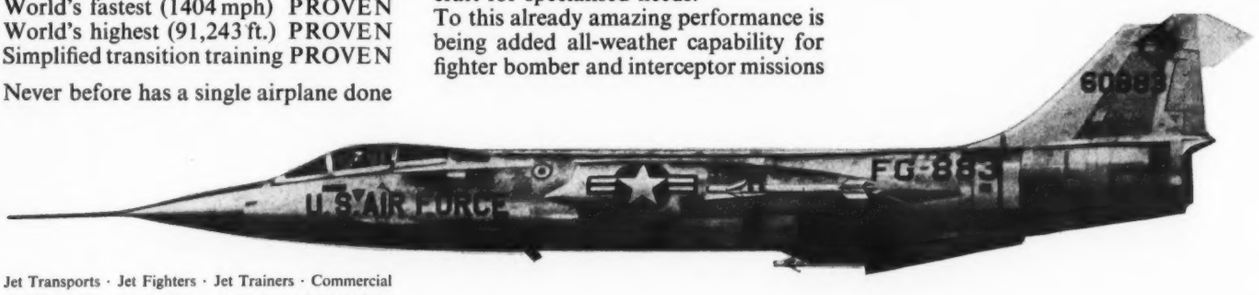
Low cost maintenance . . . PROVEN
Low cost operation . . . . . PROVEN
World's fastest (1404 mph) PROVEN
World's highest (91,243 ft.) PROVEN
Simplified transition training PROVEN

Never before has a single airplane done so many things so well as the present US Air Force version: Interception, Air Superiority and Bombing—and with so low proven maintenance and operating costs.

In addition to holding the world speed and altitude records the F-104 recently established seven time-to-climb records. The famous "missile with a man in it" has been still further developed to meet the specific needs of West Germany and other allies requiring a multi-purpose fighter instead of several separate aircraft for specialised needs.

To this already amazing performance is being added all-weather capability for fighter bomber and interceptor missions and also an advanced reconnaissance capability.

West Germany selected the Starfighter for purchase and manufacture under licence after a two-year evaluation period during which Defense Ministry experts investigated and flight-tested airplanes made by 12 competing manufacturers. Canada will build the F-104 under licence to equip eight squadrons of the Royal Canadian Air Force serving with NATO.



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WEAVER

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It's the same on the big airports now.
AIR BP service runs deep under the
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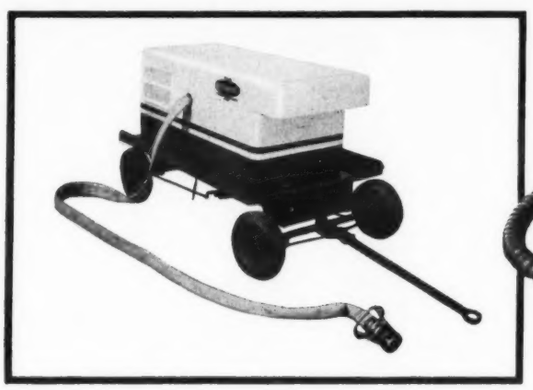
that bring fuel to aircraft without movement
of big vehicles. Hydrant fuelling is part of
the AIR BP faster-fuelling plan—
a concerted attack on time-on-the-ground figures
to enable air operators to achieve
the last minute of utilisation.

AIR BP

THE AVIATION SERVICE OF BRITISH PETROLEUM

GROUND SUPPORT FOR JET AIRCRAFT- *by* AIRESEARCH



Gas turbines have been proved in the field as the most versatile and reliable power sources for the ground support of both commercial and military jet aircraft. AiResearch gas turbines have started more jets than those built by any other manufacturer.

Besides starting main engines, these ground support units supply continuous flow pneumatic power for air conditioning and heating, compartment pressurization, snow and ice removal, and electrical power for checkout and ground operation of electrical systems.

They allow completely automatic, pushbutton operation and run on any jet engine fuel or ordinary kerosene. They provide immediate starting without warmup and operate in weather extremes from −65°F to +130°F. Each model can also supply 400 cycle electrical power with the addition of a 60 to 80 KVA alternator.

A Volkswagon truck, with an AiResearch unit, becomes a complete pneumatic and electric power plant, with all parts easily accessible through wide doors. It provides greater ease of handling because it can be driven frontward into position and can be operated from inside the heated cab.

A Trailer unit provides pneumatic and electrical power and can be towed singly or as part of a train to wherever needed.

A Fly-away air transportable unit—the same turbine and control panel as used in the vehicles can be placed in an airplane's luggage compartment for use in occasional or widespread flight operations and emergency starts. It is equipped with lightweight skids and handles.

The Garrett Corporation, through its AiResearch divisions, is the world's largest producer of small gas turbines—8,000 in operation. For information, write The Garrett Corporation, 26 Rue de la Confederation, Geneva, Switzerland.

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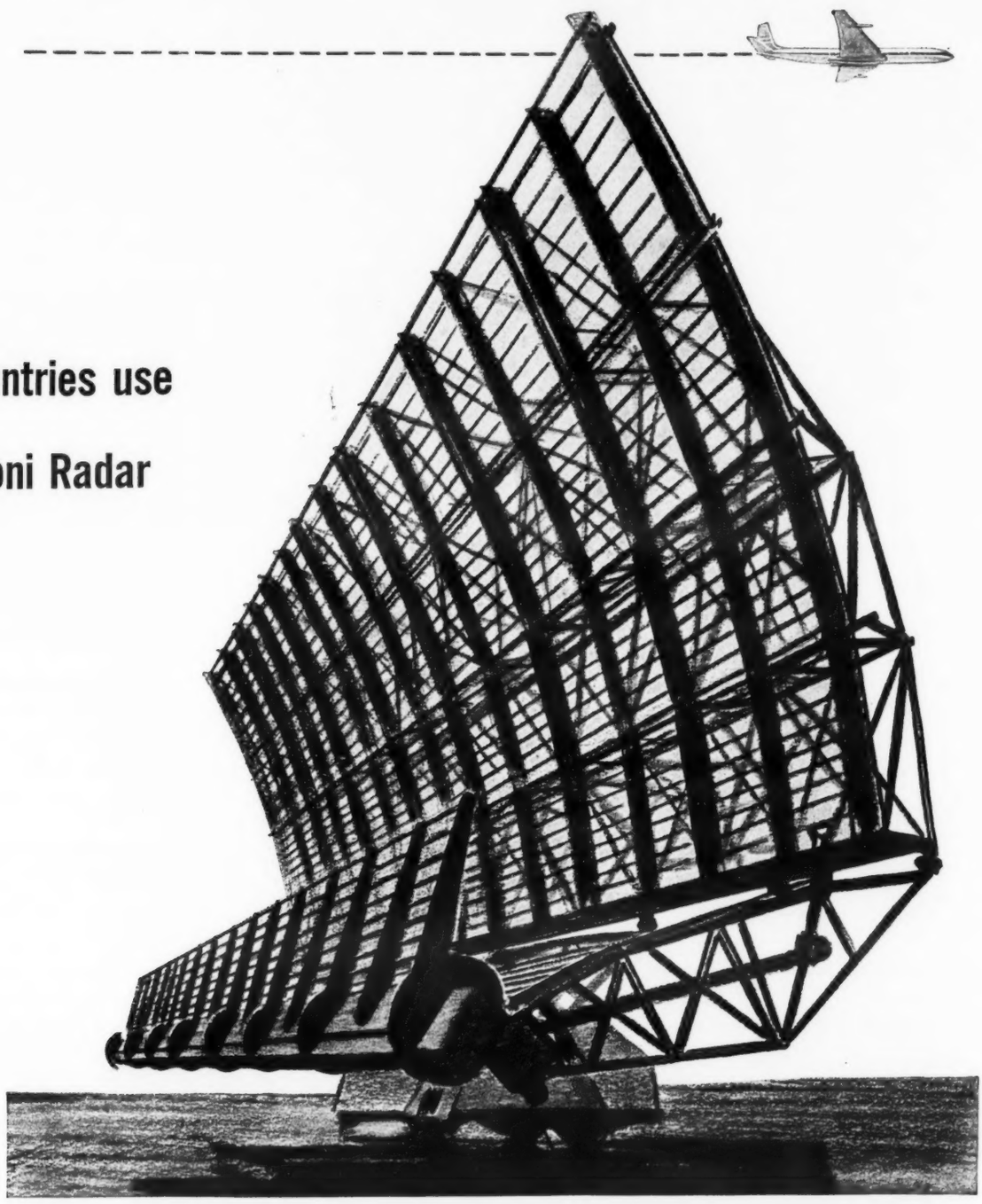


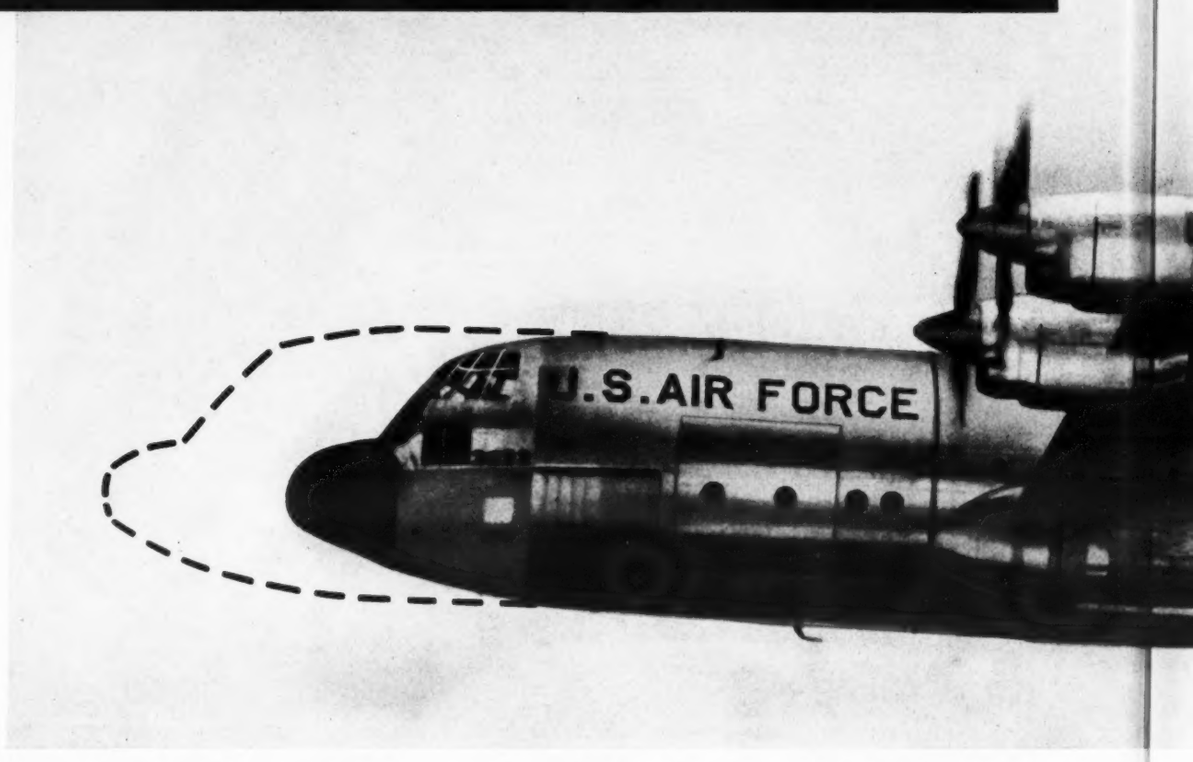
MARCONI

COMPLETE CIVIL AND MILITARY RADAR INSTALLATIONS

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

M 6R

New Lockheed Super Hercules
Big brother of U. S. Tactical Airlift champ

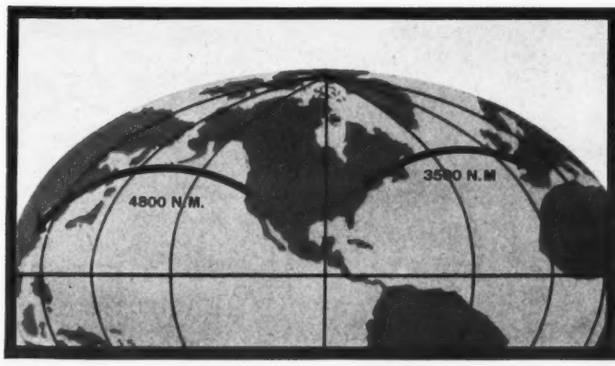


An ocean-spanning logistic support transport, the GL-207 Super Hercules is a "stretch" version of the C-130 Hercules — famous for its headline-making feats in over two years of service with USAF's Tactical Air Forces.

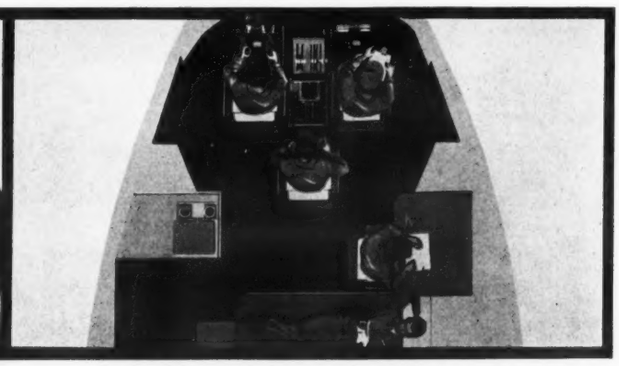
The GL-207 Super Hercules has a fuselage 23 feet longer than its brawny brother's. Its wing span is 12 feet greater... its propeller-diameter has been expanded by 2½ feet... internal fuel capacity has been increased to 10,236 gallons for greater range (pylon tanks add another 1800 gallons).

Powered by four new GM-Allison T-61 Prop-Jet engines, the Super Hercules provides nonstop trans-Atlantic and trans-Pacific transport for personnel, vehicles, palletized/containerized freight, missiles, and general cargo. Maximum payload: 78,000 pounds.

The GL-207 Super Hercules will come off production lines at Lockheed's Georgia Division. Like all Lockheed aircraft, the Super Hercules is designed for long life, easy maintenance, and low cost of operation. Result: maximum airlift, for minimum dollars.

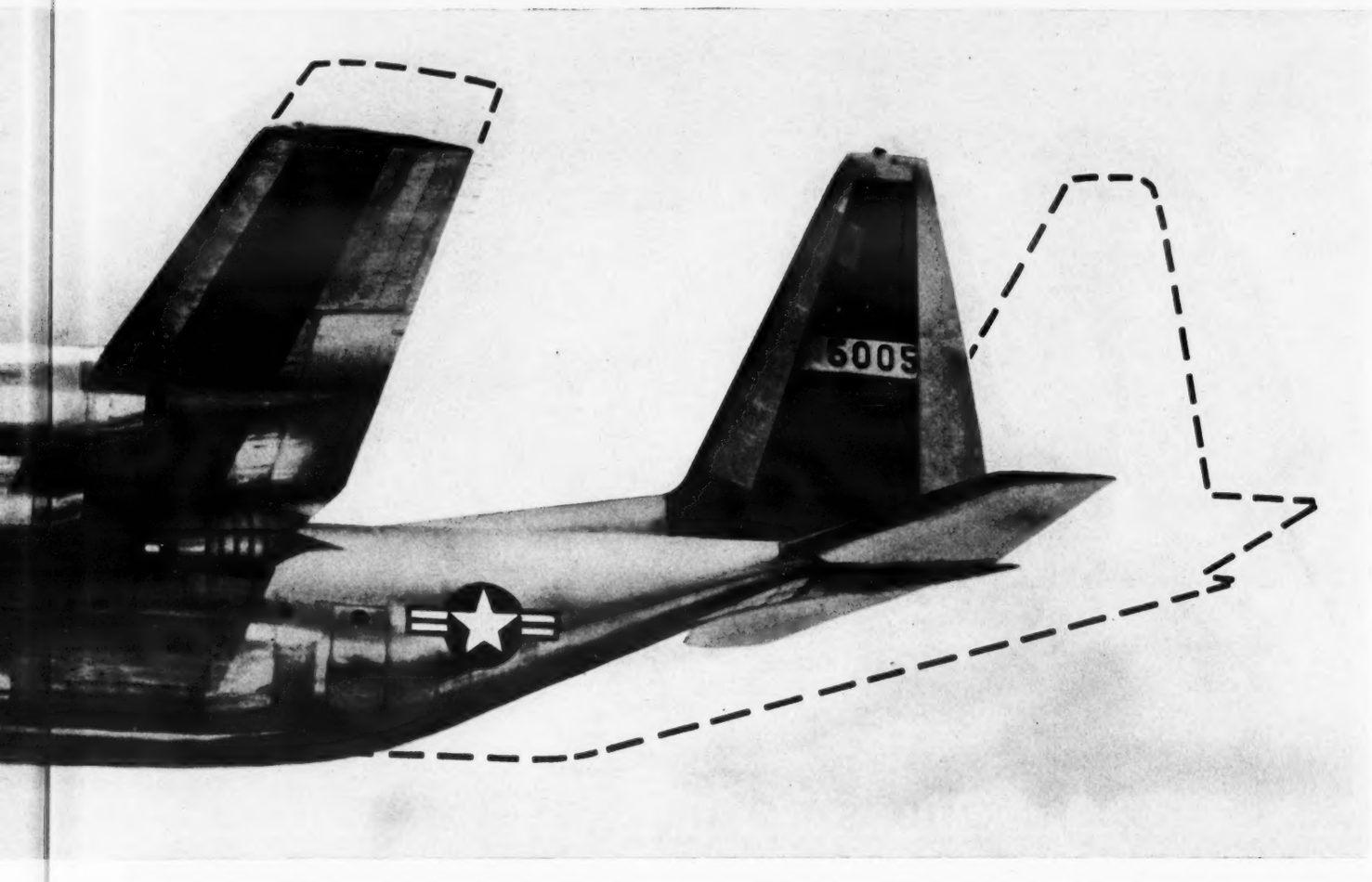


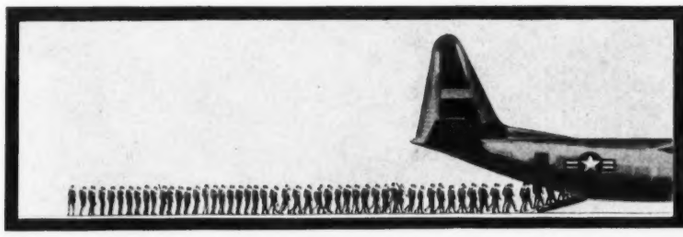
Transporting 50,000-pound MATS cargoes nonstop across the Atlantic — or, with pylon tanks, spanning the Pacific nonstop carrying 16-ton loads 4,800 nautical miles — is Super Hercules' mission.



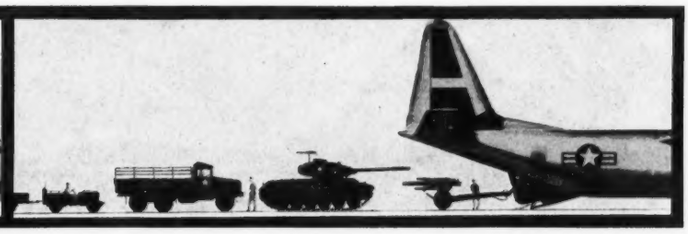
Crew efficiency on long flights is assured by flight station design approved by experienced transport pilots. Super Hercules' crew compartment includes relief crew sleeping space, galley facilities for hot meals in flight.

Dotted line shows size of GL-207 Super Hercules, superimposed over now-in-service C-130 Hercules.

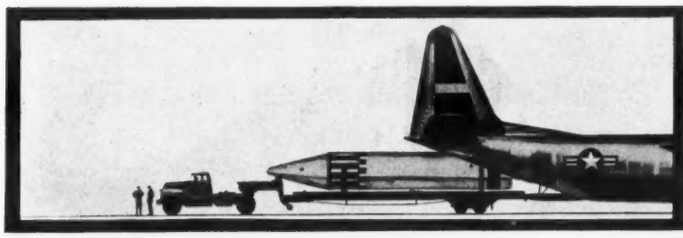




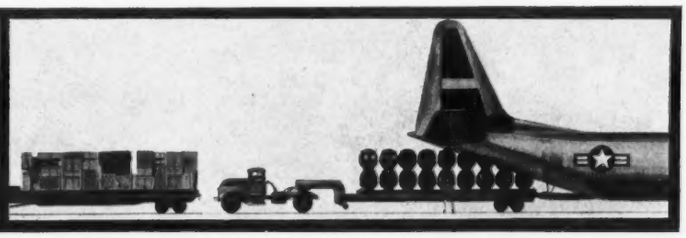
152 combat-ready troops, or 116 paratroopers can be transported in the GL-207. With airline type seats, the Super Hercules can carry 105 persons comfortably.



Combat vehicles can be driven up the hydraulically controlled ramp-door of the end-loading GL-207 Super Hercules — a vital time-saver in emergency situations.



Big ballistic missiles — assembled, with boosters, on trailers, or dollies — fit easily into the huge pressurized cargo compartment of the GL-207 Super Hercules.



Assorted cargo — runway matting, jet engine containers, fuel and oil drums, etc. — can be speedily loaded onto Super Hercules' truck-high cargo floor.

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. . . take one easy step into the luxurious comfort of a cabin cradled beneath a high wing for greater stability. Step up to higher speed and higher flying in this over-the-weather, all-weather business twin. Ask your distributor for a trial flight, and you'll be convinced that Aero Commander is a step ahead of anything in its field!

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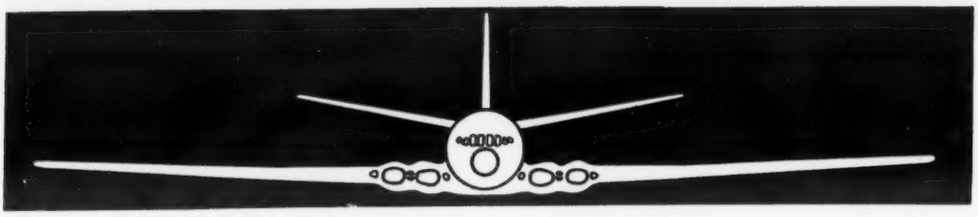

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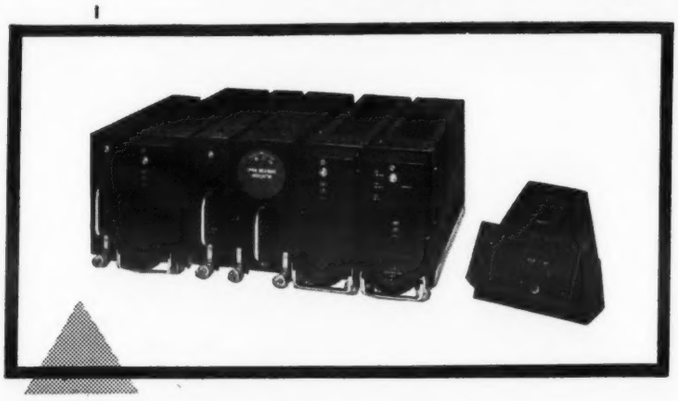
A new concept in airborne Radio Equipment



Approx. half the weight, half the size, and half the power consumption of equipment it replaces!

ST.23 Transmitter. 360 channels, 50 kc/s channel spacing, in the band 118-135.95 Mc/s. 20 watts telephony.

SR.23 Receiver 560 channels, 50 kc/s channel spacing, in the band 108-135.95 Mc/s. All spurious responses at least 90 db down.

SR.34 V.O.R./I.L.S. Localiser Receiver. Comprises a Receiver and Instrument Drive Unit. The receiver is identical to and interchangeable with the SR.23. 100 channels, 100 kc/s channel spacing, in the band 108-117.9 Mc/s (50 kc/s spacing incorporated, and available when required).

SR.35 Glide Path Receiver. 20 channels in the band 329.3 to 335 Mc/s.

SR.36 75 Mc/s Marker Receiver. (Superheterodyne).

Operates from 115 volts. 400 c/s, single phase A.C. and 28 volts D.C.

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For rescue and many other missions, the Sikorsky S-62 Turbine-Powered Helicopter gives unmatched service . . .

The amphibious S-62 with boat hull and turbine power is capable of hovering at 15,000 feet with full gross weight. Rescue missions can be performed as high as 22,500 feet. The S-62 has a range of 245 miles and will carry a useful load of 2900 pounds. For other typical missions it can carry an external load of 2500 pounds on a cargo sling, or 12 passengers plus crew, or it can tow with 4000 pounds tension. The rescue hoist capacity is 600 pounds. Dynamic components of the S-62 have been proved by over 1,000,000 flight hours.

SIKORSKY AIRCRAFT, Stratford, Connecticut, U.S.A.

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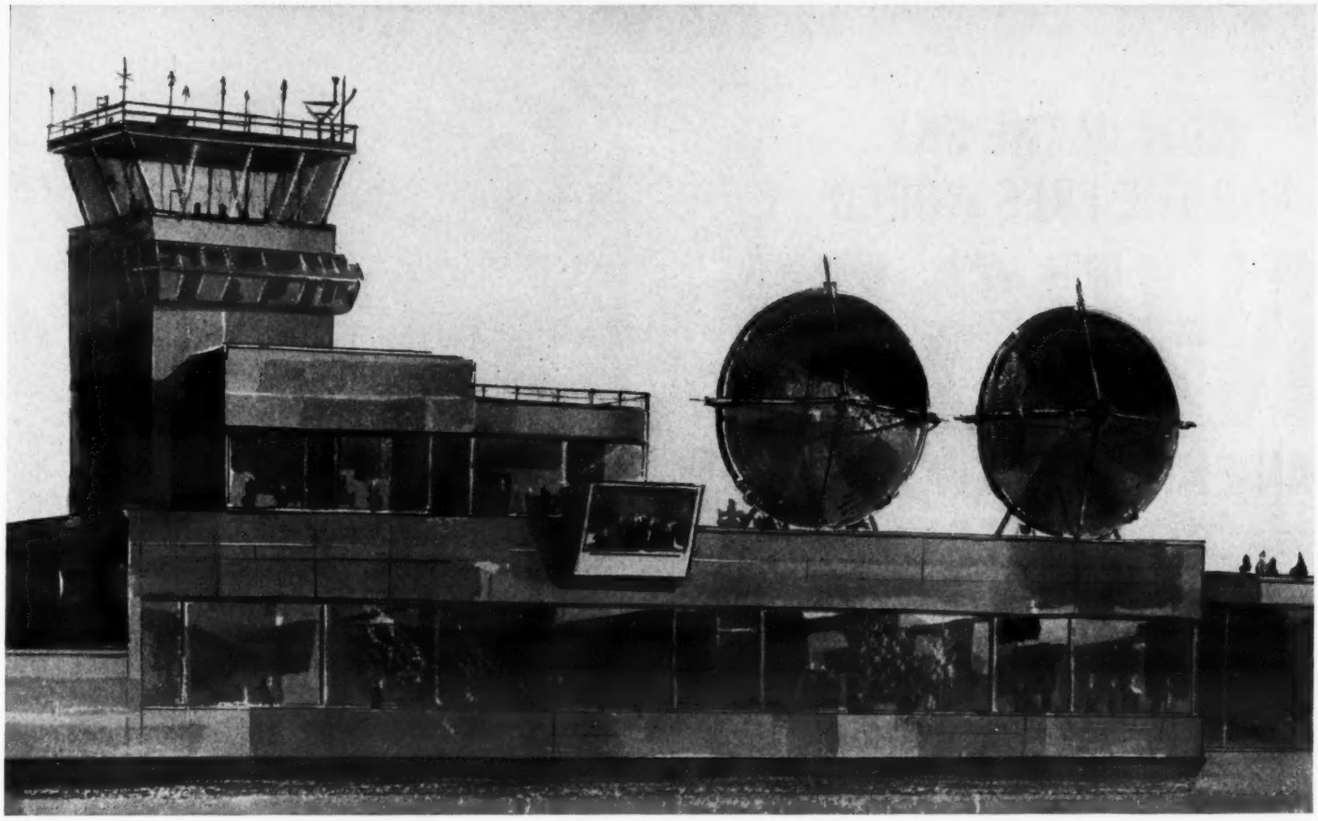
DEDICATED TO DEFENSE

This unusual, most advanced facility will produce vital precision guidance and control products for aircraft, helicopters, missiles, anti-missiles and space vehicles.

Lear



REMOTING RADAR DATA with

Canadian Westinghouse Microscatter

Now, Air Traffic Control from remote installations can be relayed *instantly and simultaneously* to points 100 to 200 miles distant!

Receiving signals from search radar, a remote MICROSCATTER unit can relay raw wideband video to airport control towers, command points or operation centres. Identical signals are received at all points at the same time. Data is transmitted *without* conversion into digital form. Communications are made with maximum speed and accuracy. MICROSCATTER also establishes long-distance links *between* control points.

Here are some of the proved-in-service features Westinghouse MICROSCATTER offers you:

- **BROAD BAND TRANSMISSION** of 5 mc. for sending high-quality raw video, azimuth, elevation, control and synchronization data.
- **FREQUENCY BAND** of 4400-5000 mc. will not interfere with radar operation.
- **HIGH RELIABILITY** of up to 99.99% in any weather with quadruple diversity.
- **SPAN** 100 to 200 MILES in a single hop.
- **LOW POWER**—Transmitter output 2 KW.
- **COMPACT EQUIPMENT** is ideal for remote installation. A complete repeater system can be mounted in a 40′ tractor trailer, or units can be delivered by helicopter.
- **LOW COSTS** of antennas (10′ to 28′ diameters), unattended operation, simple installation, low power consumption, easy maintenance all add up to substantial savings with MICROSCATTER radio.

MICROSCATTER APPLICATIONS

COMMERCIAL	MILITARY
Fixed Station —120 voice channels —television and sound	Wide Band —radar —data —120 telephone channels
Transportable—48 voice channels —teletype	Tactical and Transportable —48 voice channels —teletype —data

For complete information, write to Canadian Westinghouse Company Limited, Electronics Division, Hamilton, Canada.

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N-156 F

AN ENTIRELY NEW KIND OF FIGHTER!

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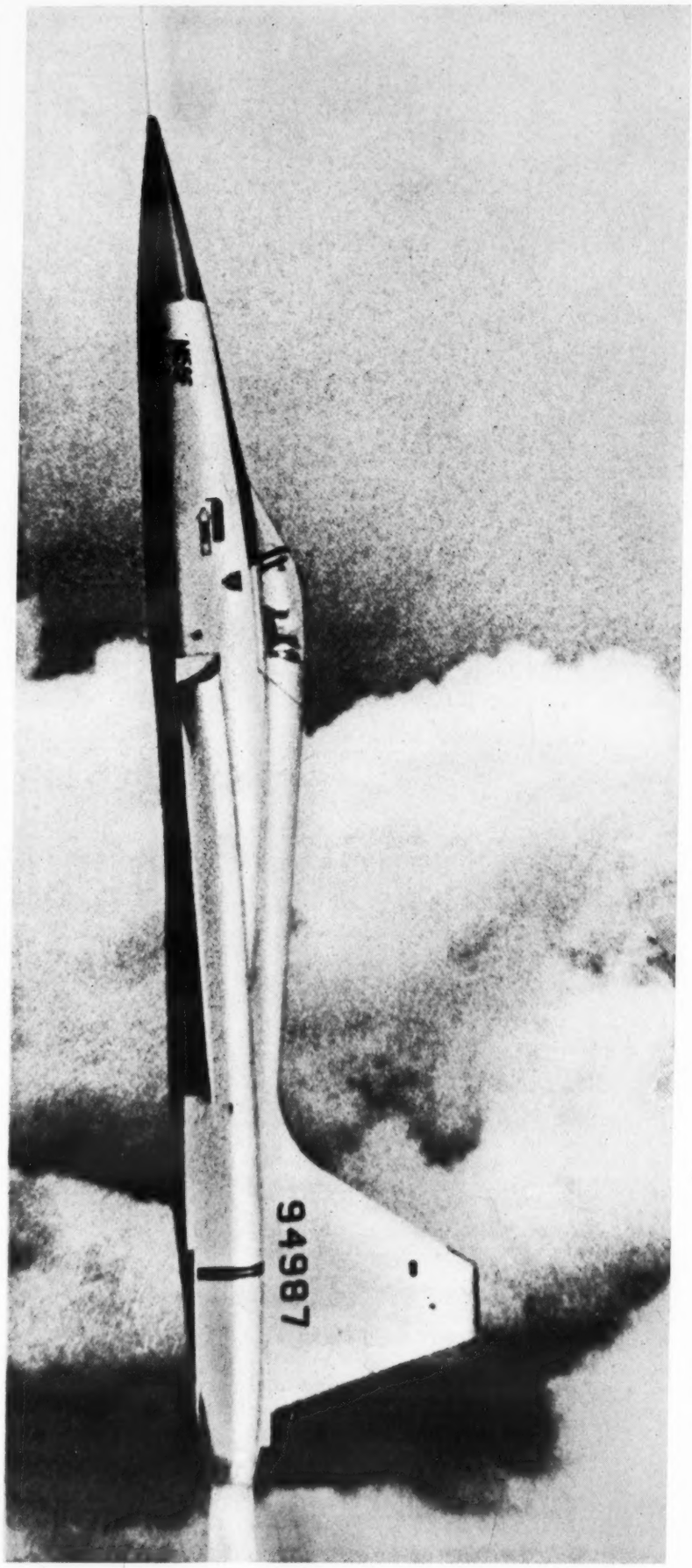
Northrop's N-156F is the first airplane U.S.-designed specifically for defense needs of the other Free World nations. The Freedom Fighter takes advantage of new jet engines, new lightweight materials, new design technology that no other fighter yet reflects. With its multi-purpose mission capability, performance, and ease of operation, the N-156F can virtually double a nation's effective fighting force.

This is because the Freedom Fighter is lighter, smaller, and easier to operate. Light, simple design cuts procurement costs, results in fuel savings and ease of maintenance. The Freedom Fighter cuts by approximately 50% the need for heavy, costly ground support and rare skills.

This highly reliable airplane can take off any time – almost anywhere–scant seconds from the scene of possible air or ground combat. This mobility contributes to quicker reactions. It keeps more aircraft battle-ready along a wider and more dispersed perimeter for maximum striking power–with minimum vulnerability. As a multi-purpose fighter, the N-156F flies air-to-air, air-to-ground, and low-altitude strike and reconnaissance missions.

No weapon system today matches the Freedom Fighter's advantages. It costs less to buy, to fly and to maintain. And because the N-156F is designed for production outside the United States, this new fighter will contribute to the economies of the countries it will defend.

Test pilots use the word "clean" to describe the N-156F's performance. Their reports praise its low- and high-speed flight handling characteristics. They find the new fighter meets and exceeds all the performance indicated and assured by extensive wind tunnel tests. They appreciate its twin-jet safety – its all-weather dependability.



NORTHROP INTERNATIONAL

A Division of **NORTHROP CORPORATION**
Beverly Hills, California, U. S. A.

The London Space Congresses

About two weeks before the Soviet *Lunik II* made its successful trip to the moon, two space congresses held in London brought together nearly 1,000 scientists and technicians from all parts of the world for an open discussion on the aims and limitations of astronautical research. On August 27th, five years after a Government commission of inquiry had said its last word on the *Comet* accidents, Church House in Westminster opened its doors to the first Commonwealth Spaceflight Symposium. It was but a short step from the teething troubles of jet transport to a serious discussion of the problems of space flight, for four days later, in the same building, British Minister of Supply Aubrey Jones welcomed delegates to the 10th Annual Congress of the International Astronautical Federation (IAF) with an address sent by President Eisenhower.

In lively discussion delegates from 30 countries thronged the corridors and auditorium of the home of the Anglican Church under the astonished eyes of primates who, immortalized in oils, must have marvelled to hear, not of the human soul's salvation, but of the physical survival of mice and monkeys hurtling through space.

★

Even the organizers of the Spaceflight Symposium, the British Interplanetary Society (BIS), were surprised at the attendance ; instead of a small group of between 50 and 100 experts, no less than two hundred delegates came to learn about the British Government's projects and efforts in the astronautical field or to express their own opinions on the Commonwealth space programme. British industry was represented in strength for the first time, and the discussions and the technical papers on which they were based left no doubt as to what types of space programme Britain and the Commonwealth could undertake and approximately what the cost would be.

BIS Chairman Dr. L. R. Shepherd gave the following summary of the situation in his introductory remarks :

" Could the Commonwealth afford the diversion of money, men and industrial effort which would be required to make a contribution which would stand up to comparison with the 'Big Two' ? The answer is yes, but the thing would require careful planning and control over the use of the available resources ... What would be the cost? It is difficult to put things in specific terms, but £20 million increasing to £50 million per annum would keep the Commonwealth in the picture. The U.K. could easily afford to meet half this commitment without noticing it. Canada could also make a fairly substantial contribution. "

It is likely that as a result of the Symposium the Government may take a second look at space research, which under the present limited programme merits a miserable £300,000.

The Symposium papers produced a spate of new ideas, and it is significant that no fewer than seven of the nineteen papers presented came from the Hawker Siddeley Group alone. This concern has already spent considerable sums of its own money on research and design work in the astronautical sector and will certainly have more to say for itself in the future. H. R. Watson, of Armstrong Whitworth, spoke on a project for a pyramid-shaped manned space vehicle, while Dr. W. F. Hilton, of the same firm, reported on a new type of ramjet powerplant for speeds of Mach 5 to Mach 10. By giving the ramjet a special form with a convergent-divergent longitudinal section Hilton proposes to spontaneously ignite the entire air-fuel mixture at supersonic speeds by shock heating. The air velocity inside the duct would always be greater than Mach 1 and would be much better controlled than in present ramjets with ignition at subsonic speed. Possible applications of the ramjet would be as the second stage of a multi-stage space vehicle or as an extra booster for a long-range ballistic missile. Dr. O. H. Wyatt, of Hawker Siddeley Nuclear Power Co., forecast the shape of things to come in his paper " Feasibility of Nuclear Fission Rockets ".

As for getting U.K. satellites into space, manned or unmanned, the only vehicles available are the *Black Knight* research rocket or the *Blue Streak* long-range missile. The security veil was lifted to allow G. K. C. Pardoe of de Havilland Propellers to give a most interesting outline of an astronautical programme using these two liquid-propellant rockets (with new third stages) as boosters for various satellites and space probes.

★

For the foreign visitor the Commonwealth Spaceflight Symposium was the overture to the 10th International Astronautical Congress of August 31st to September 5th, so far the largest and undoubtedly the most successful one held by the IAF. The world's press followed the public sessions with more intense interest than ever before, and it is therefore pertinent to recall some of the major decisions taken. In the first week of the conference came the long-awaited announcement that an Academy of Astronautics was to be founded, with Professor Theodore von Kármán as President of the Organizing Committee. At the final business session Professor Leonid Sedov was elected President of the IAF for the coming year, though hopes that the next annual Congress would be held in Moscow were not fulfilled. The 11th IAF Congress will meet in Stockholm in September 1960, while the 12th will be held in Denver, Colorado.

The papers, over 80 in number, showed even more clearly than in 1958 that, from the hobby-horse of starry-eyed optimists, astronautics has become a highly respected branch of science. The dissertations, whose number increases from year to year, are now based no longer on hypothesis, but on a wealth of practical experience.

Successful Moon Flight

While Soviet and American scientists were crossing swords at the 10th IAF Congress in London, preparation for the latest Russian space exploit were going ahead somewhere in the Soviet Union. Then, on September 13th, the world learnt that a Soviet rocket carrying measuring instruments and the flag of the USSR had hit the surface of the moon at 21:02:24 hours GMT that day. According to Tass reports the booster and instrument capsule were similar to those carried by *Lunik I*, launched on January 2nd, 1959. The burnt-out final stage, which hit the moon shortly after the instrument package, weighed 3,324 lb empty, the instrument payload in its ball-shaped capsule 860 lb. The final stages of the first successful trip to the moon were tracked by the radio telescope at Jodrell Bank, England. " The cessation of signals within one minute of the predicted time indicated a successful hit on the moon's surface, " said Tass.

It has since been announced that the measuring equipment carried by *Lunik II* recorded no lunar magnetic field and no surrounding belts of radiation, but revealed that the concentration of ionized particles in space increased within about 6.000 miles of the moon. Information released by Russian sources concerning the rocket guidance system does not indicate that any mid-course guidance or correction was used after final burnout of the rocket stages. Data telemetered from the rocket during the first 30 minutes of flight indicated that the container would strike the moon as planned. It did, in fact, hit at an angle of 60° to the moon's surface 500 miles from the centre of the visible face of the moon.

KLM 1919-1959

As KLM, founded by the Dutch Flight-Lieutenant Albert Plesman, was registered as a company on October 7th, 1919, the Netherlands airline is among the six oldest carriers in the world and has played a decisive role in building up world air traffic.

" The public is still somewhat unwilling to make use of the new method of transport, in spite of extensive publicity and advertising ... " said KLM's first company report.

This statement is hardly surprising, for between May 17th and October 31st, 1920, the period corresponding to the report, KLM had transported, all in all, 345 passengers, just over 48,000 lb of freight and 6,600 lb of mail.

Today the company's *daily* average is over 3,000 passengers, 176,000 lb of freight and 17,500 lb of mail, transported over a world-wide route network covering 160,000 miles.

The November issue of *Interavia* Review will contain an illustrated report on how the Dutch company has attained the leading position it holds today.

INTERNATIONAL MEETINGS AND CONFERENCES

Oct. 4th-16th : Seventh Anglo-American Aeronautical Conference. New York.

Oct. 5th-12th : International Communications Conference and Exhibition. Genoa.

Oct. 7th-10th : Air Traffic Control Assn. 4th Annual Meeting. Oklahoma City, Okla., USA.

Oct. 8th : IATA Executive Committee. Tokyo.

Oct. 8th-10th : Society of Experimental Test Pilots, Symposium on " Pilot's Role in Space Exploration ", Beverly Hills, Calif.

Oct. 8th-10th : American Society of Tool Engineers, Semi-Annual Meeting. St. Louis, Mo., USA.

Oct. 10th : Eidgenössische Luftfahrtkommission 14th National Air Transport Conference. Lucerne.

Oct. 10th-15th : National Association of State Aviation Officials, 28th Annual Meeting. San Francisco, Calif.

Oct. 12th-14th : National Defense Transportation Assn., 14th Annual National Convention and Logistics Forum, Seattle, Washington, USA.

Oct. 12th-14th : National Electronics Conference, sponsored by Illinois Institute of Technology. Chicago, Ill.

Oct. 12th-16th : IATA, 15th Annual General Meeting. Tokyo.

Oct. 14th : Aachen Technische Hochschule Science Faculty Conference on " Space Flight : Its Tasks and Possibilities ". Essen.

Oct. 14th-17th : Annual Meeting of the Wissenschaftliche Gesellschaft für Luftfahrt. Hamburg.

Oct. 16th : IATA, Executive Committee. Tokyo.

Oct. 16th : Annual Meeting of the Canadian Owners and Pilots Association. St. Jovite, Que.

Oct. 22nd-23rd : VDI Automation Congress. Stuttgart.

Oct. 26th-28th : IRE Professional Group East Coast Conference on Aeronautical and Navigational Electronics. Baltimore, Md.

Oct. 26th-28th : Air Industries and Transport Association of Canada Annual Meeting. Montreal.

Oct. 26th-30th : 1959 National Conference of the Society of Photographic Scientists and Engineers. Chicago, Ill.

Oct. 27th : Series of lectures on Digital Computers by Professor Dr. H. Cremer. Essen.

Oct. 27th : Radar & Electronics Association : " Electronics in Supersonic Flight ", by F. W. Page.

Oct. 28th : R.Ae.S. Graduates' and Students' Section : " Setting of Aircraft Specification ", by R. H. Whitby.

Oct. 28th-29th : Eighth Annual Computer Application Symposium, sponsored by Illinois Institute of Technology. Chicago, Ill.

Oct. 28th-30th : Aircraft Electrical Society, Annual Industry Display. Los Angeles, Calif.

Nov. 2nd-4th : IAS National Midwestern Meeting on " New Frontiers in Aviation ". Wichita, Kansas.

Nov. 9th : IATA Traffic Conference 2 Agency Committee, 33rd Meeting, Lisbon.

Nov. 16th-20th : National Aviation Trades Association 1959 Convention. Washington.

Nov. 16th-20th : 5th International Automation Congress and Exposition. New York.

New York Finance Notes

Investment Companies' Dealings in Aircraft Stocks

BY SCOTT HERSHEY, NEW YORK

Purchases and sales of shares by the investment companies should serve as a fairly reliable barometer for the situations of the firms whose stocks are quoted on the exchange, since the former are obliged to make a particularly careful choice and to avoid reckless speculation. For this reason the report from our New York Stock Exchange correspondent is of especial interest.
Editors.

The tightness of the money market and the possibility that it will become even tighter has caused a somewhat depressed market with the volume lightening to a low for nearly a year and a half.

One of the most persistently laggard items continues to be the aircrafts, with some of them backing to repeated new lows for the year, although there wasn't much selling to be absorbed.

The New York Stock Exchange in a recent list of the most active stocks during the first six months of the year showed two aviation securities among the 25 volume leaders. One was Pan American, in this group for the first time with 2,447,600 round lot sales reported as compared with 484,416 in the same period a year ago, and Boeing with 2,137,600 reported round lot sales as compared with 1,591,000 during a like period in 1958.

It is interesting to note that there are no aircraft or airline securities in the so-called " Favorite Fifty ", compiled by Vickers Associates in their guide to investment company portfolios.

This analysis ranking by dollar value the listed stocks most popular with professional management covers the holdings of 293 investment companies, including 63 closed-end investment companies and more than 190 open-end (mutual funds) with investible assets of approximately $20 billion. Dropped from the Favorite Fifty in the recent analysis was United Aircraft.

However, this does not mean that the investment management groups were ignoring aviation securities. A survey of the June quarter by The Commercial and Financial Chronicle of changes in common stock holdings of 67 investment management groups indicated that the aircraft industry met the maximum of divergent reactions.

How the investment companies assess aircraft firms and air carriers is clear from a brief survey of their buying and selling during the second quarter of 1959.

Aircraft Industry

North American Aviation, Lockheed and Martin all enjoyed good buying by the mutual funds. Five managements purchased a total of 131,600 shares of North American, while one management sold 60,000 shares. Two managements purchased 146,000 shares of Lockheed, which was somewhat offset by the sale of 93,900 shares by four managements. Six managements purchased a total of 76,900 shares of Martin, and there were no reported sales by the investment management groups of these shares.

Four investment companies purchased a total of 20,000 shares of United Aircraft during the period, but seven companies sold a total of 44,300. There were no reported purchases of Douglas and sales of only 630 shares. Two investment companies purchased 1,400 shares of Bendix Aviation and two sold a total of 6,500 shares. Only 4,000 shares of Curtiss Wright were reported on the purchase side, while one management sold 14,900 shares of this stock.

Boeing was hard hit with one management purchasing 7,500 shares, while eight managements sold a total of 146,940. Two management companies purchased 9,800 shares of Marquardt Aircraft, and one sold 2,300 shares of the same company. There were no purchases of Aerojet General noted in the survey, but three management companies sold a total of 5,600 shares of this stock.

Airlines

Among the airlines, only KLM went through the period without encountering any selling, while two investment companies purchased a total of 17,400 KLM shares.

On the other hand there were no purchases of Braniff reported, but two investment companies sold 19,700 shares. One investment company purchased 2,000 shares of American Airlines, but three managements sold a total of 17,800 shares of the line.

Eastern found buyers among the investment companies, two of them purchasing a total of 50,544 shares. Three managements sold a total of 3,200 shares of Eastern during the same period.

There was only selling in Pan American with two managements disposing of a total of 53,900 shares. One management purchased 4,100 shares of United Air Lines and two sold a total of 8,319.

An interesting adjunct to the advent of the jet age is that it is adding thrust to hotel profits as well as to airlines operating the jets, particularly for those near air terminals.

Williard E. Dodd, president of Knott Hotels Corp. which operates hotels at Idlewild International Airport in New York and in London, reported that gross operating receipts for both the International Hotel in New York and the Westbury in London have shown remarkable increases.

He said that while occupancy rate of hotels in general is up over last year, the Westbury and the International have jumped much higher and that a major reason for this must be attributed to the jet. With new hotels at both ends of the jet trans-Atlantic route, Knott's earnings for the first six months of this year were the highest in history.

Dodd is looking forward to the era of the short-range jets which he firmly believes will further expand travel with its attendant benefits to the hotel industry.

" Just as the automobile and the new highways have had their effect on the planning and operations of hotels located outside major metropolitan areas, the jet plane's influence on future hotel operations in such cities as London, New York and other major jet terminals will be very great," Dodd said.

TWA FLIES MORE PASSENGERS MORE MILES

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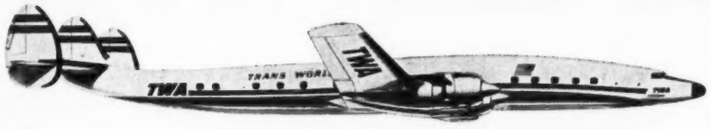

There's a reason for this Leadership. People *like* TWA. Over the years, passengers have learned that they can depend on TWA for on-time arrivals, operational efficiency and that extra service on the ground and in the air which makes TWA the Leader in world travel. If you are flying the Atlantic remember, non-stop really means non-stop on TWA's All-JETSTREAM * service to the U.S.A. The JETSTREAM is the world's most proven long range aircraft. And for the convenience of those who fly the finest, TWA flies more non-stop flights to the U.S.A. than any other airline. On TWA you get there in one single smooth flight, rested and relaxed.

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HERE ARE THE FACTS ON 1958 TRAVEL

	PASSENGERS CARRIED	PASSENGERS MILES × 1,000	MILES FLOWN × 1,000
TWA	4,723,159	4,592,675	117,753
TCA	2,775,781	1,617,541	47,632
BEA	2,760,147	961,213	35,171
PANAM	2,656,326	3,893,530	103,867
AIR FRANCE	2,400,700	1,984,904	51,134
SAS	1,525,413	1,157,744	38,674
SWISSAIR	1,058,715	630,245	20,451
SABENA	954,630	802,189	27,755
KLM	910,880	1,229,364	40,272
IBERIA	749,547	338,438	12,143
LUFTHANSA	550,114	412,749	14,239
BOAC	465,263	1,422,235	39,874
ALITALIA	221,271	224,233	7,730

Source : Flight Magazine, London

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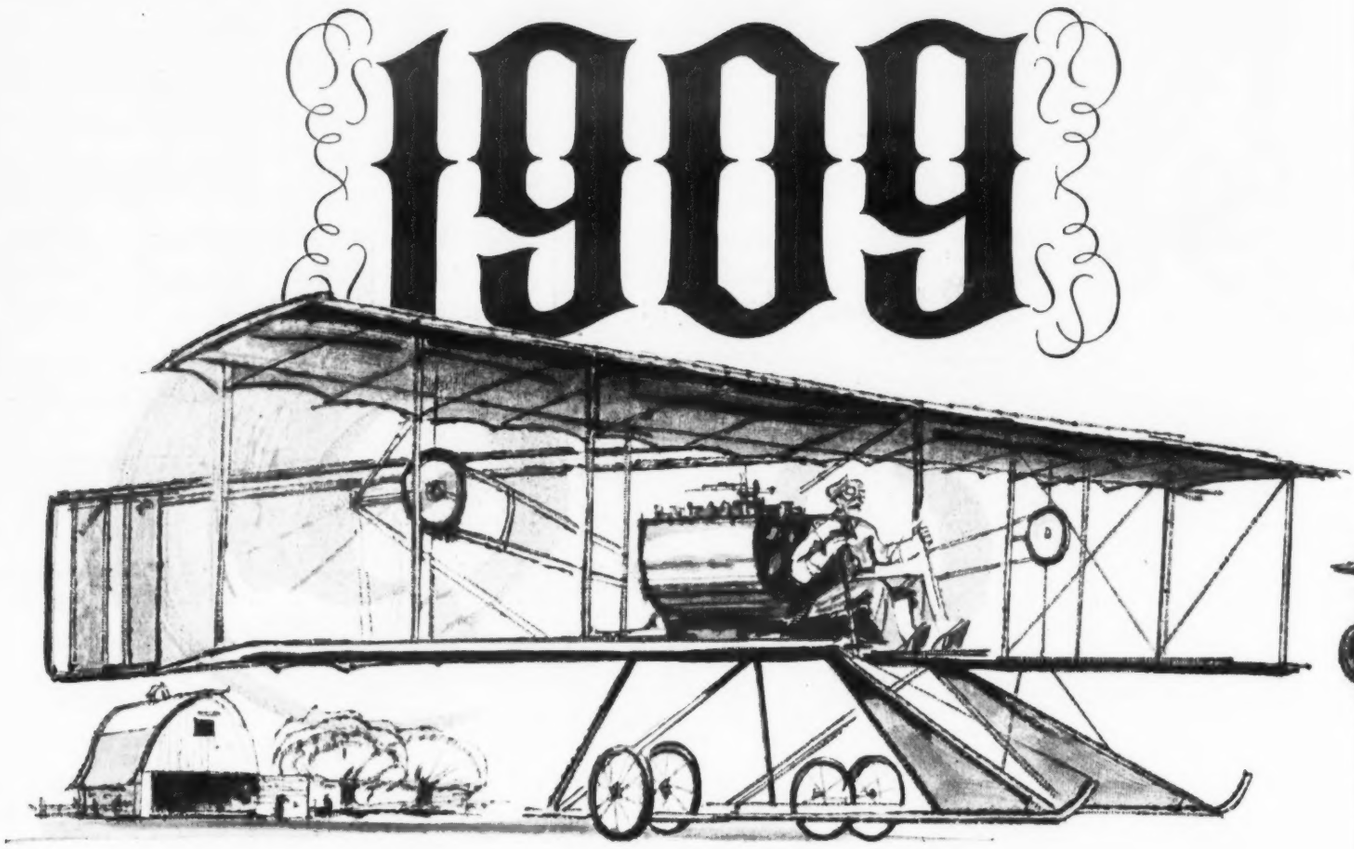

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FIRST low-pressure pneumatic airplane tire – the Airwheel.

FIRST brake designed specifically for aircraft.

FIRST fully automatic system of ice detection and ice elimination for aircraft.

FIRST magnesium alloy airplane wheel.

FIRST tubeless tires specified for commercial airliners.

FIRST successful self-sealing fuel tank.

FIRST complete line of nylon cord tires for high-speed aircraft.

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1959

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NEW REINFORCED RETREADING. Goodyear is now qualified to retread jet airliner tires to the most demanding specifications.

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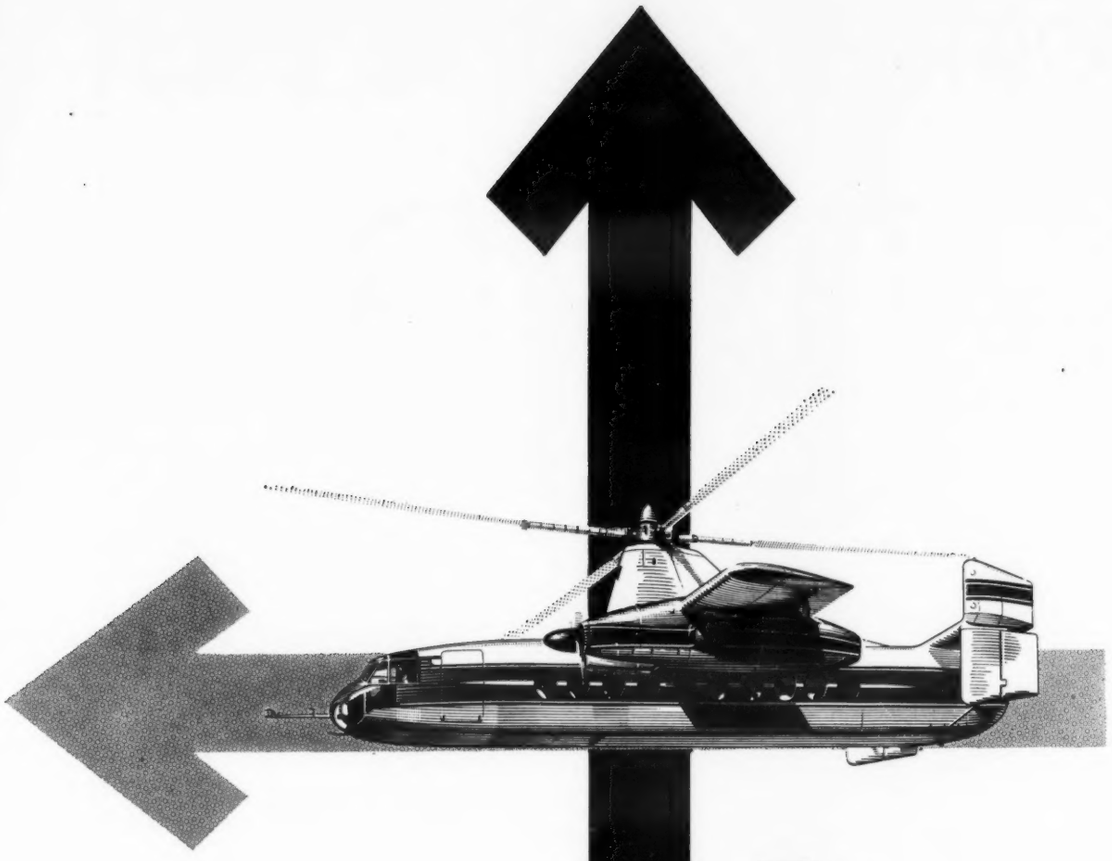
THE ABILITY TO ANTICIPATE the ever-changing needs of airlines throughout the world has been the main factor in Goodyear's 50 years of aviation progress. Now—as the industry shifts to jet power – Goodyear stands ready to meet the challenge of longer ground distances, faster landings, higher loads. We're anticipating those needs now – developing still more Goodyear pioneering achievements for tomorrow and far into the future.

WRITE TODAY for full information to: Goodyear International Corporation, Aviation Products Division, Akron 16, Ohio, U.S.A.

YEAR



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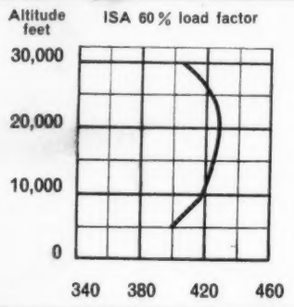
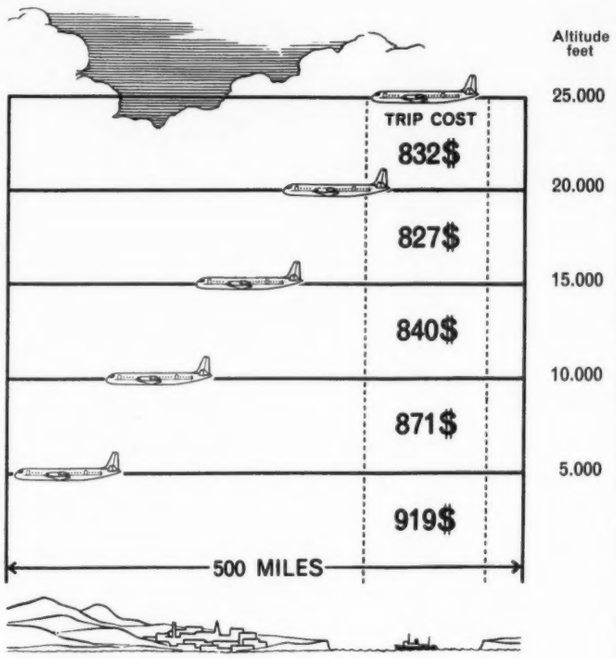


SPEED CAN BE MAINTAINED WHATEVER THE ALTITUDE ROUTEING INSTRUCTIONS



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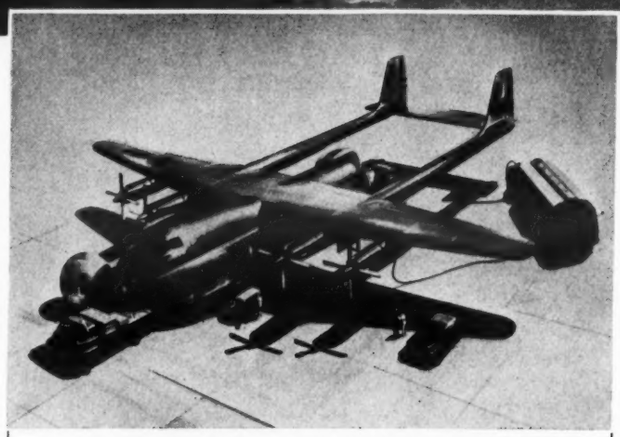

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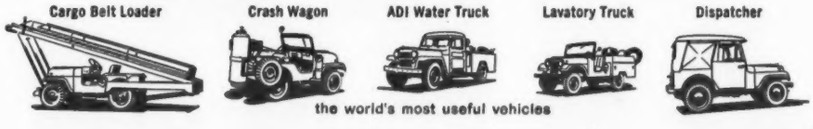

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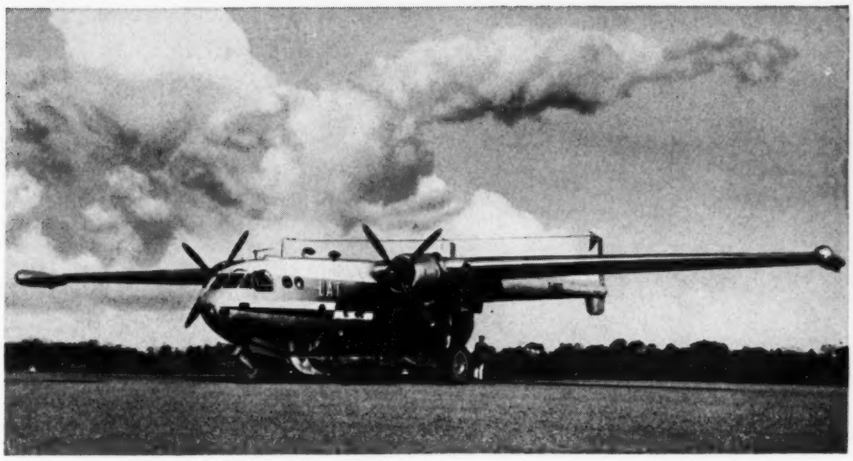

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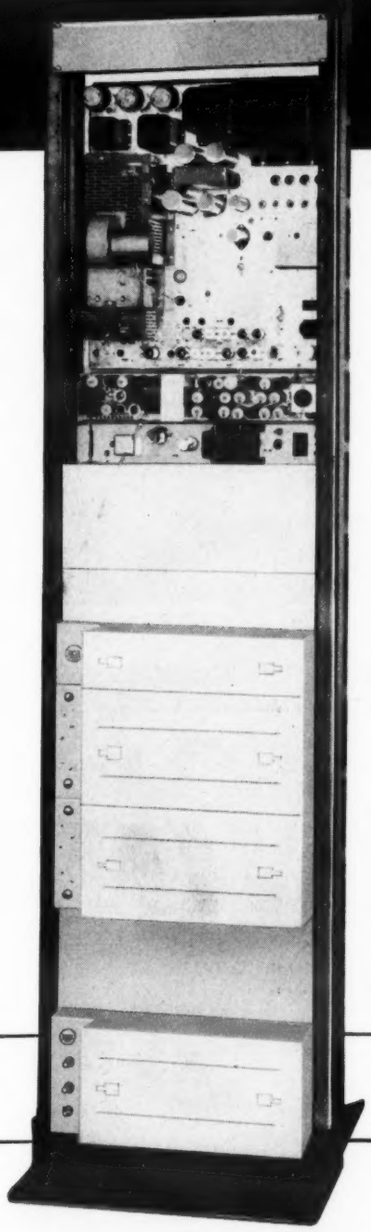

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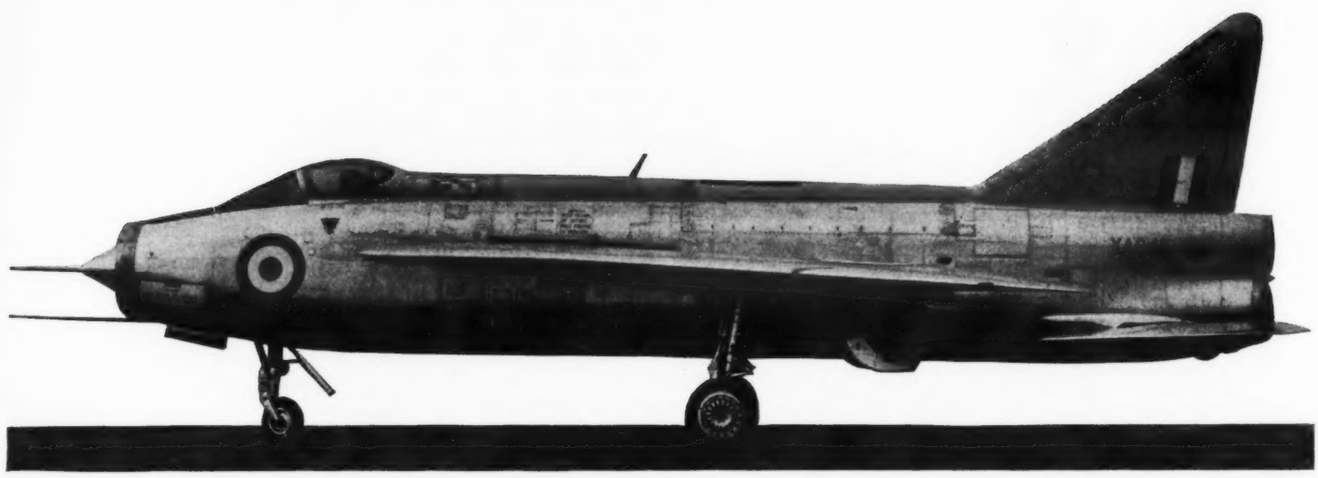

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INTERAVIA

The 15th IATA Annual General Meeting

Tokyo, October 12th to 16th, 1959

The "parliament of the world's airlines" will be meeting in Tokyo between October 12th and 16th, 1959. Whereas last year the International Air Transport Association held its Annual General Meeting in New Delhi, this time the presidents of the ninety member companies, with their ladies and staffs, will be travelling to the Far East. Already Sir William Hildred, the Association's polyglot Director General, is probably memorizing a few friendly sentences in Japanese, so that he can weave them into his opening speech. And the proverbial Japanese hospitality, which has already persuaded many travellers from all over the world to choose Japan Air Lines for their flights across the Pacific, will do much to ensure the success of the meeting.

JAL's President Seijiro Yanagita, who becomes President of IATA for a year on October 12th, IATA Director General Sir William P. Hildred and his Public Relations Officer S. Ralph Cohen, without whose presence no IATA General Meeting is conceivable, have each written a message of welcome to introduce the present issue. And the traditional ceremonial will certainly not be absent from this year's gathering, yet...

*

Yet the "rising sun in the Far East" seems likely to have a background of darker clouds.

Following the example of Pan American World Airways, a great many of the IATA member airlines have plunged into heavy expenditure during the past few years, in connection with large-scale orders for turbine-powered aircraft. Unless all the signs are misleading, certain companies will be increasing their commitments still further, as nobody wants to lag behind his competitors. All this despite the fact that some of the airlines are already struggling with financial problems, and pretty well all of them are racking their own or their electronic brains as to how they are to fill their new turbine aircraft in addition to the piston-engine transports they all still possess. Moreover, in his remarks below, IATA's Director General hints softly that all is not quite as it should be in the matter of ground organization. And the aircraft manufacturers, for their part, are observing their commitments more meticulously than ever, as – with few exceptions – the industry's cash situation is rather more tense than it was before military customers became quite so grudging with their orders. Nevertheless...

*

Nevertheless it should be possible to find a graceful way out of the difficulty.

A few weeks before the Annual General Meeting, however, there will probably have been some slightly heated discussion behind closed doors; the tariff experts were due to meet in strength at Honolulu, Hawaii, on September 14th, 1959, to sort out once again some ten thousand different rates and fares.

From the air transport experts' lamentations published periodically in the newspapers and trade press, it emerges clearly that, what with constantly rising costs, unreduced taxation and the vast sums invested in flying equipment, the airlines' profit margin is constantly shrinking. It will also be remembered what bitter fights ensued not so long ago when Pan American World Airways demanded drastically reduced fares on Atlantic tourist and economy services, fights which shook the IATA organization to its foundations. Eventually the PAA attack ended happily, but the forthcoming IATA Traffic Conference in Honolulu will find itself facing a new trial.

In a statement to the House of Commons in mid-July, Britain's Minister of Transport and Civil Aviation Harold Watkinson gave a brief foretaste of what will be taking place in Honolulu: "...We believe that the world is doing itself out of a very big rise in airline passengers by the refusal of IATA to have a sensible method of reducing world aircraft fares. Therefore, I want to say, with the Government's full support, that BEA and BOAC and the independent airlines will go to the IATA Conference in September determined to press for a reduction in fares. What they want is a fare reduction on the European, African and Eastern routes, and I say with all seriousness that I hope IATA will approve this proposal. If it will not, we shall have to reconsider our position in IATA, and also, if it will not, we shall have to consider what we can do in our own cabotage area, where matters are still under our own control. I say that if we cannot get an orderly reduction by IATA, we shall have to do the best we can with our own resources, as well as considering our position in IATA."

It will be seen, the Minister was in no mood to mince matters. He even repeated his warning, with the evident desire to underline its solemnity. Perhaps he has learned from Juan Terry Trippe that a hint at rate war or withdrawal from IATA can weaken even the most stubborn spirits.

*

The British Minister may well have been expressing the heart-felt desire of many airline presidents, with his demand for lower fares to attract new passenger categories. But not all airlines have cabotage areas under their own control. Indirectly, too, Harold Watkinson was pleading the British aircraft industry's cause, since it has for years specialized in the production of turboprop aircraft which, it boasts, are particularly economic.

A reduction in airline fares? Provided it is possible to avoid a rate war and the undermining of airline finances, Transport Minister Watkinson and the presidents of the British airline corporations can only be applauded, in the interests of the travelling public. Let us wait and see...

*

Wait and see, for by the time these lines appear in print the Honolulu party will probably have ended, and by the time the contenders get to Tokyo they will once again be greeting each other with friendly smiles. British aviation experts also maintain that the airlines could operate profitably at half the present fares, but do not produce supporting figures.

While on the subject of fare reductions, reference must also be made to the question of reducing aviation insurance premiums. Here, however, the British will be on the defensive rather than the offensive. For years London has been the citadel of the aviation insurance companies. But the initiated will not have forgotten that aviation insurance premiums were sharply increased – by 10 to 40 percent – last spring, which does not greatly help to make air transport more economical, let alone encourage drastic fare reductions.

The IATA Annual General Meeting may therefore this time discuss the possibility of forming its own insurance pool, rather on the lines of the Clearing House. Although these rumours have so far had no official confirmation, they should perhaps be passed on to the reader.

*

But enough of problems. In Tokyo delegates will remember that it is just forty years since the first air passengers were carried and the foundation stones of IATA laid. In these four decades many other difficulties have been mastered, and nobody could deny that air transport has changed the face of the world. Today, in the jet age, passengers are virtually queuing up at the booking offices. Designs for supersonic transports are already on the drawing boards in both the Old and the New Worlds. And – who will bet? – they too will sooner or later find purchasers and passengers. *EEH*

IATA

IATA Ready to Meet Challenge of Jet Age

By Seijiro Yanagita,
President, Japan Air Lines, Tokyo

SEIJIRO YANAGITA, who at the Annual General Meeting in Tokyo becomes IATA President for 1959–60 in succession to J. R. D. Tata, President of Air-India International, was born in 1893, graduated from Tokyo Imperial University as a Doctor of Law, and went into the banking business, rising to the office of Deputy Governor of the Bank of Japan. After a brief period of activity in the chemical industry, he was appointed by the founders of Japan Air Lines to be the national airline's President and Managing Director. Picture: President Yanagita and Mrs. Yanagita. Editors

The era of jet flight will change many things in the world as we have known it. Because of this the Fifteenth Annual General Meeting of the International Air Transport Association to be held in Tokyo will be one of the most significant in the Association's 40-year history.

This is only the second time that IATA has met in Asia. It is a matter of great pride to me and to Japan Air Lines that the site of this year's gathering is the capital of Japan. We are all conscious of the honour of the occasion.

Japan Air Lines feels strongly the responsibility shared by all 90 members of IATA—of meeting the challenge presented by the development and expansion of jet flight.

Even now, as IATA members settle into their jet schedules or prepare to embark upon this new, swift form of travel, many questions of the future are being posed. Will it be possible for jet airliners to provide inexpensive transportation for large numbers of people? Will it help to overcome some of the barriers to neighborliness that still exist in the world? How will it affect world commerce?

All these questions, and many more besides, must be answered. Most of the answers will inevitably find their beginnings in IATA activities, both in the annual IATA parliament and in the various traffic conferences. This is natural because IATA represents 90 percent of the world's scheduled international air traffic in passengers, cargo and mail, and what IATA does as a matter of policy formulated by its members and approved by members' governments is bound to set the future course of air traffic in the world.

Examine for a moment what IATA has achieved in its 40 years of existence. Carriers have linked individual routes into a single, integrated public service network of airways, with standard tickets, waybills and other documents, with coordinated procedures, and with the same world-wide standards of operation and care for passengers and cargo.

Yet this is only the beginning. Already the young jet age is presenting new problems, new opportunities, new and provocative ideas for the future. This jet age, and what must inevitably follow, the rocket age and the age of nuclear power plants, will change completely the world as we know it.

It is my hope that the dramatic manner in which jet travel will throw the peoples of the world closer together in greater numbers and more frequently, will serve to bring us at last to the threshold of complete understanding. This is all possible, I am certain. I am equally certain that IATA will stand in the forefront of the crusade against mankind's greatest dangers—ignorance, fear and hatred. It will be IATA's task to guide the world into the jet age smoothly, safely, intelligently. It will also be IATA's task to make sure that, as the jet age develops, people everywhere are prepared for its enormous changes, understand it, utilize it and come to regard it as a friend and a guide to a broader and more enjoyable concept of life.

Forty Years of Cooperation under IATA

By Sir William P. Hildred, C.B., O.B.E., Director General, International Air Transport Association, Montreal

International air transport and international cooperation in air transport are now 40 years old. Many airlines have celebrated their 40th anniversaries this year. So has IATA. So, in a sense, does ICAO, since it was in 1919 that its predecessor organization was founded.

Forty is not a particularly glamorous age and it is not one of the milestones which are habitually given special celebration. But it is an age at which one normally attains maturity and begins to attain wisdom.

One of the signs of mature wisdom is patience, tolerance and an ability to take the long view. I should like to take this opportunity to apply this kind of perspective to the revolutionary developments of turbine-powered transport which have now come upon us.

By every possible indication, the next decade will see an explosive upsurge of air traffic within and between all the continents. Its effects on the living, thinking and earning habits of men and women in all parts of the world will be equally explosive.

Like every explosion, it probably will raise a good deal of dust. It will put heavy stress on the airlines, on governments and on the elaborate and delicate machinery by which their efforts are combined and their interests adjusted in order to keep traffic flowing. But I am convinced as well that the new jet age will constitute a real achievement in international cooperation and good sense.

*

The 90 members of IATA themselves employ more than 350,000 men and women, but that figure pales into insignificance in comparison with the employment to which the industry gives rise elsewhere—the millions who are employed in airports, in the factories of the airframe and engine and accessory manufacturers and at oil fields and refineries.

It has given rise to new industries around every new airport (and they are legion) because of the facility with which goods can be made and immediately shipped off by air with the minimum of ground handling.

The old difficulties of customs, currencies, passport and immigration regulations, visas and health checks have eased up after a decade of international fight, and in this respect I can only feel that the jets will be an even more powerful solvent. Their speed of arrival makes a mockery of many outworn prejudices and fears, and the numbers they carry make a mess of any customs shed where there is a too-conservative bureaucrat in charge.

But it is not only in the matter of political frontiers that the jet will make itself felt. It will give a further impulse to the wave of tourism which started seven years ago when the tourist fare was first introduced in the tariffs of the airlines. The jets will demand bigger markets, and the one most susceptible to increase is international tourism for the economy class passenger.

While this coming explosion of air traffic cannot help but have a wide range of beneficial results, it also will create new problems. The jet aircraft is, after all, only part of a transport system. It is dependent upon other facilities and services, all of which must be adapted to accommodate it and to enable it to reach its maximum operating economy.

A greatly increased traffic will tax airline arrangements for sales, bookings and other phases of traffic handling, and it certainly will tax the capacity of most existing airport terminals. The changing characteristics of airline route patterns and traffic flow over many routes will affect the balance of agreements between governments which make international commercial flight possible to begin with.

The weather ahead, therefore, may be sunny, but it also will be blustery, for airlines, for the civil aviation administrations of governments and for their foreign offices as well. Yet I feel certain that the turbulence will only be temporary and that it will not throw us off our steady course of progress.

Role of the Annual General Meeting

By S. Ralph Cohen, Public Relations Officer, International Air Transport Association, Montreal

S. Ralph Cohen, Public Relations Officer to IATA, was born in Elizabeth, New Jersey, on July 9th, 1917. After graduating from Union College, he became Chief of Public Relations for the Hudson River Navigation Corporation in 1937. From 1938 to 1943 he was legislative reporter for a number of newspapers; 1943–1946 editor of the National Aeronautical Magazine. Since 1946 he has worked for the International Air Transport Association. *Editors*

IATA has fallen into the habit of calling its Annual General Meeting "the parliament of the world's airlines." Like all easy descriptions, the phrase is not entirely accurate, for IATA is entirely non-political. The General Meeting may have its internal politics (it would be strange indeed if it had not), but it deals only with the purely functional business of cooperation between airlines to keep flying on the international network safe, economical and efficient.

Yet the fact remains that within its own community and its terms of reference, the IATA General Meeting is the source of ultimate authority and the legislative assembly. However, it is neither as powerful nor as exclusive as the "gentlemen's Club" of the United States Senate, nor as vast a "cave of the winds" as the United Nations General Assembly. It does, however, resemble these bodies in certain other ways: it works according to a written constitution; it is entirely democratic in composition and procedure; and it does its work largely through committees.

The General Meeting holds the purse strings, for it alone can approve the annual budgets and assess members for the dues which support IATA. It elects the Executive Committee, the President and the executive officers of the Association, and designates the various standing committees through which IATA's creative work is done. Further it can organize such airline traffic and rates conferences as may be required or permitted by governments; and it can set up regional groups of members to deal with local problems.

As in the Senate and the U.N. Assembly, representation in the IATA General Meeting is based on the rule of equal voting power for every active member, regardless of size, strength or influence. Unlike them, however, the General Meeting cannot be said as a practical matter to have the final word as to the qualifications of its members. Under the Articles, any airline is eligible for membership in IATA which carries on scheduled international operations for public hire under the flag of a government which is itself eligible for membership in ICAO; in effect, this means that the last word lies with governments, in this as in so many other matters with which IATA is concerned.

Even in the event of expulsion of a member from IATA for cause—a theoretical possibility for which the Articles provide, but which has never arisen in practice—the last word is said by a process of arbitration which can involve the International Chamber of Commerce.

There are no vetoes in the General Meeting, and action is by majority vote. However, the General Meeting has on occasion and by unanimous consent agreed that questions of overriding importance must carry only by a substantially larger vote than a mere majority (e.g. in the voting on the proposed transfer from Montreal to Geneva; Ed.)

Another phrase which has been attached to the IATA General Meeting is "the assembly of presidents". It has been this since the very beginning of IATA's existence 40 years ago—the one point in the year when the effective heads of the scheduled international carriers can meet and consider together their mutual problems and their possible joint solutions. With the years, however, the increasing complexity of air transport and of IATA's own organization, which must move in pace with it, have worked somewhat of a change in the role of this meeting of presidents. In IATA's early days, the General Meeting was IATA. These were the days in which it was possible for one man to know all there was to know about the operation of aircraft, the commercial side of air transport, and the organization of his airline. And in those days, the presidents disposed of all of IATA's business themselves. It was the General Meeting which handled the minutiae of standardizing forms and procedures, coordinating timetables, and agreeing on the first rudimentary technical standards.

But as air transport developed and new departments and vice presidencies were added to the corporate structure of airline companies, the General Meeting began to delegate some of its work. By 1930, technical matters had been hived off into a Technical Commission and a Radiotelegraphic Committee, and other groups of the same sort were later added.

*

When the new IATA rose in 1945 out of the ashes of the old, its founders gave constitutional recognition to what had been empirical practice and created the series of standing committees on Financial, Legal, Technical, Traffic and Medical matters under which most of IATA's work is organized today. Other aspects of its labour, such as Postal, Facilitation, Public Relations and Enforcement matters, are carried on under the general direction of the Executive Committee. Each of these committees, through its Chairman, reports in detail to the General Meeting.

An additional difference between the pre and postwar IATA is the rise of the Traffic Conferences, in which the carriers negotiate patterns of international fares and rates for approval by government. The General Meeting does not itself carry on these negotiations, but it creates the Conferences and provides for their administration through the Executive Committee.

The General Meeting is thus the apex of the IATA pyramid, and all that is done elsewhere in the Association must eventually come there to prove itself.

One of the first offices created in the old IATA was that of the Rapporteur General, who was charged with reviewing the performance of the past year and pointing out the future trends. That officer has disappeared in the structure of the new IATA, but the function remains: at the opening of each General Meeting, the Director General not only reports on the activities for which he is directly responsible, but also discusses the position of the industry as a whole as he sees it, in order to put the work of the Meeting into perspective.

In another sense, the General Meeting can also be a mediator and court of last resort in questions which the specialized bodies cannot resolve. The vexed question of the 1958–1959 jet surcharge is a case in point: the Conferences preceding the 14th Annual General Meeting could come to no agreement on it, and while the Meeting itself could take no constitutional action, its discussions at the presidential level helped bring final settlement among the vice presidents when the Conferences reconvened.

These strictly constitutional functions, however, are not all that occupy the General Meeting during its annual five days of sessions. Just as other bodies, the Meeting has a busy and fruitful life in the corridors and behind the potted palms in the delegates' lounge. In many cases, a quiet talk at the General Meeting has ironed out many an interline conflict at a lower level or has paved the way for cooperation between two or more companies.

Air transport, of course, cannot be divorced from the context of the community which it serves; and here lies another important function of the General Meeting. Its sessions are purposely peripatetic, moving each year to a different country and, if possible, to a different continent. Each new meeting place provides an opportunity for the presidents to sample and assess its potentialities and attractions for further traffic development from all other parts of the world air network.

In five days at Tokyo, then, the 15th Annual General Meeting of IATA will listen, review, discuss and act—formally and informally—on all of the many matters in which airlines must cooperate in order to maintain efficient, dynamic and expanding international traffic. The final resolutions and even the more detailed minutes of their proceedings will be only a partial record of its accomplishment. The full story will be read from the development and progress of the industry itself over a decade or more to come.

Ignoring the mythological "paddle-wheel flying boat" belonging to the bald-headed gentleman from Ki Kuang, who makes his splendid appearance in so many aviation stories, complete with wife in kimono and umbrella... the story of Japanese air transport covers a total span of 39 years. It began early in 1920, when the Civil Aeronautics Bureau was set up under the Japanese Ministry of War and encouraged a number of private operators to open services on a limited domestic network.

Of the 39 years of Japanese civil aviation, however, some five to six were lost because of war operations (the war in China and World War II) when civil air transport took a back seat far behind military transport, and another seven years, between 1945 and 1952, when the Allies prohibited any form of flying activity in Japan. There therefore remains roughly 25 years, during which Japanese commercial aviation has shown an astonishing vitality.

The best proof of this is provided by the following figures: in the 1953–54 business year (April 1st to March 31st) Japan Air Lines carried 84,107 passengers, in 1958–59 this number had risen to 454,744, and the personnel strength had grown from 253 to 2,300.

Seijiro Yanagita, President of Japan Air Lines.

Shizuma Matsuo, Vice President of Japan Air Lines.

Kinjiro Yuchi, Managing Director for Finance and Property.

Tetsuo Oba, Managing Director for Operations.

Yoshito Kojima, Managing Director for Sales and Traffic.

Kikue Urashima, Managing Director for General Affairs.

Ryohei Ito, Managing Director for Planning and Public Relations.

Benichi Akiyama, JAL Director.

JAL yesterday and today ...

Like their European contemporaries, the Japanese began their commercial air services with surplus military aircraft. But being a seafaring nation, they gave first choice to seaplanes.

The first airline of any real scope was Japan Air Transport Co. Ltd. (Nihon Koku Yuso Kaisha), founded in 1928, which not only operated domestic services, but also ventured further afield, to Dairen in Manchuria and—via Okinawa—to Taipei in Formosa. In later years, its fleet consisted of Douglas DC-2s and twin-engined Mitsubishi transports.

After ten years of operation Japan Air Transport Co. was liquidated, and the Japanese Government founded the Great Japan Air Lines (Dai Nihon Koku Kaisha), a company which continued to exist only nominally as a private undertaking during World War II.

After the signing of the San Francisco Treaty in 1951, the Japanese initially had to be content with modest domestic services radiating from Tokyo, with aircraft chartered from Northwest Airlines, flown and maintained by American personnel.

The statutes of today's *Japan Air Lines Co. Ltd.*—which enjoys a Japanese monopoly on international services—were approved by the Japanese Parliament on October 1st, 1953. Just three months later, JAL opened a twice-weekly DC-6B *Pacific service,* from Tokyo via Honolulu to San Francisco. With the introduction of four Douglas DC-7Cs in April 1958, this service was operated on a daily basis until May 1959, when three of the weekly flights were diverted to serve Los Angeles. Finally, in June 1959 two flights a week were inaugurated along the Great Circle route from Tokyo to Seattle. Counting one pure freight service, JAL now operates ten scheduled flights a week across the Pacific to the West Coast of the United States.

At the same time traffic to *South East Asia* has been energetically built up. Once the ice had been broken in February 1955, through the extension of the Tokyo–Okinawa route to Hong Kong, progress was rapid: October 1956 to Bangkok, May 1958 to Singapore, early 1959 to Hong Kong.

JAL tomorrow and the day after ...

Its unusually standardized aircraft fleet—10 Douglas DC-4s, 5 DC-6Bs and 4 DC-7Cs in operation, plus 4 DC-8s on order—justifies Japan Air Lines in planning a bold, far-sighted expansion programme.

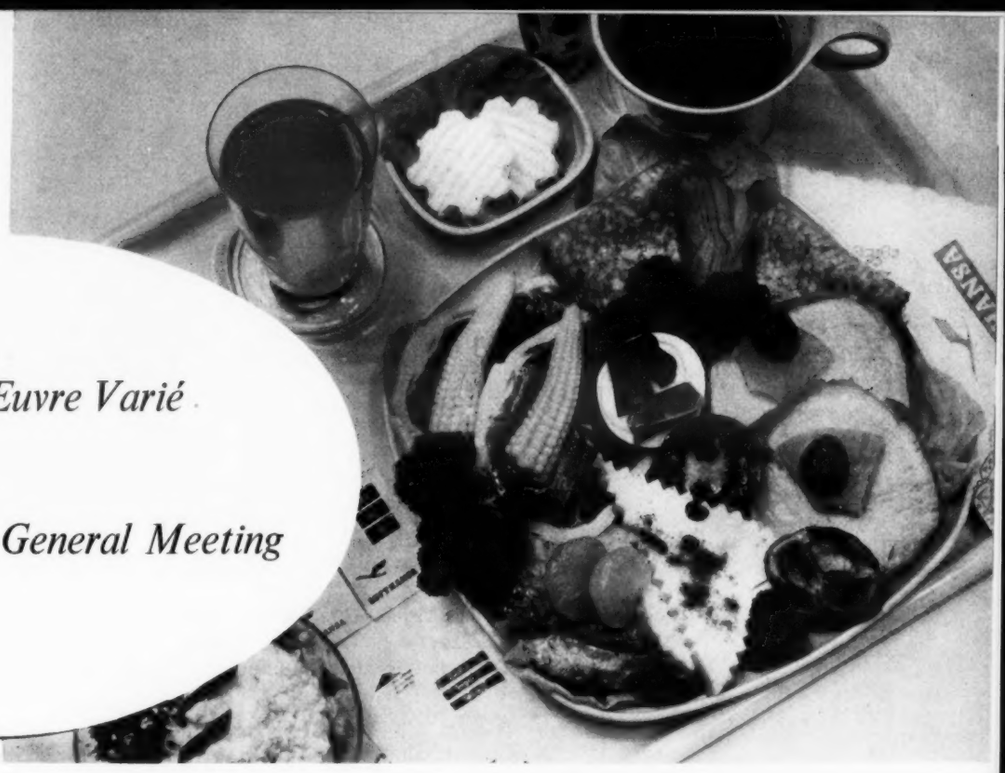
Jet services across the Pacific are due to be inaugurated in less than a year's time, in July 1960. During the same year the opening of an Arctic service Tokyo–London is scheduled, and for 1961 an extension of the South East Asia service via Calcutta–Karachi–Beirut–Rome–Paris to London. The Tokyo–Seattle route is to be continued to New York. This service too is to be carried on to London—though not until 1963—thus giving JAL its first round-the-world route.

Needless to say, in view of the constantly growing competition on the world's air routes, lengthy negotiations will be necessary before landing rights can be obtained for this ambitious programme. The company will also be obliged to set up a large number of new overseas offices. At the moment it has ticket offices in Honolulu, San Francisco, Los Angeles, Seattle, Okinawa, Taipei, Hong Kong, Bangkok and Singapore, as well as branch offices in a number of cities to which it does not yet operate—New York, Washington, Chicago, Cleveland, Manila, Sao Paulo and London.

In addition, eleven new offices will be opened before the end of the year: at Portland, Oregon; Boston, Massachusetts; Dallas, Texas; Toronto, Mexico City and Rio de Janeiro in the Western Hemisphere; in Düsseldorf, Paris, Rome and Copenhagen in Europe; and at Calcutta, India.

It goes without saying that this massive expansion of the company's activities, in both organization and equipment, will also require a corresponding broadening of the financial basis. Half of the initial capital of 100 million yen[1] in 1951 was subscribed by the Government. After an increase in capital in each of the years 1951 to 1958, a first dividend of 5 percent was paid out in 1959 in the shape of new stock issued to the company's private shareholders. This has brought the total capital up to 7,984,330,000 yen. And a further increase, to 9,387,720,000 yen, is planned for September 1959, of which the State will hold 6,000,000,000 yen worth.

[1] 100 yen equals roughly $ 0.30 at today's rate of exchange.



An Hors d'Œuvre Varié for the IATA Annual General Meeting

Eating at jet speed...

Though many voices have been raised against the pleasures of the table on board airliners, the air carriers are still convinced that the way to a passenger's heart is through his stomach. Without exception they follow the principle of diplomacy set down by Talleyrand in a letter to the King of France from Vienna: "I can assure Your Majesty that frying pans are of greater importance to my mission than written instructions."

There is, however, one slight flaw in this principle. Talleyrand had time, modern short and medium-range aircraft have none. Of what use are the most succulent steaks, the tastiest seafood, the most exquisite *bombes*, when they can be neither served nor eaten?

Thirty years ago, when the flying boats of the French carrier Air Orient operated a short-stage service across the Mediterranean, passengers sat in wicker seats balancing paper bags and thermos flasks on their knees. What of today?

In the tourist and economy classes the mathematics of sandwiches are ousting the luxury meals which have become the general rule since then. But even in the first class the short flight times of jet aircraft are gradually curtailing the carriers' hospitality and may mean a return to snack services on certain short and medium stages.

Take BEA, for instance. The following news item was recently published in the daily press: At London Airport a mother asked her daughter, who was flying to Scotland, to telephone her as soon as she landed. The daughter did as she was told, but the telephone rang in vain ... her aircraft was in Glasgow before her mother had reached her home in Kensington. Small wonder that BEA cannot serve meals on many of its domestic routes and on its shorter European routes. Before take-off, however, passengers have the opportunity to buy sandwiches at the airport cafeteria.

Even Air France, the *restaurateur par excellence*, has been placed in the same position since the introduction of the *Caravelle*. Meals must be dispensed with on certain short stages, and even on somewhat longer routes the hostess uses a trolley to take her trays down the centre gangway so that she can serve her 50 tourist-class passengers in two trips.

Before the battle: Crockery, cutlery, table linen, salt-cartons, menus and containers – it is amazing what even one of Lufthansa's 80-seat *Constellations* must carry, let alone a 140-seat jet.

Swissair has devised a method of its own for its forthcoming *Caravelle* services. As flight times on many stages are less than an hour, it is out of the question to serve a full meal on each stage. Swissair's catering service has therefore decided to experiment with a "culinary jigsaw", serving one dish on each stage; for passengers continuing over several stages these dishes combine to form a complete menu.

Even in the vast air space of the USA the shorter stages are beginning to shrink to an alarming degree and are giving American chefs some cause for concern.

"When we planned out jet catering service", *Interavia's* New York correspondent was told by the head of American Airlines' catering division, "three solutions occurred to us: persuade passengers to eat faster, serve less food, or fly the jets slower. Of course, these were all discarded as quickly as they came to mind." Instead, in true

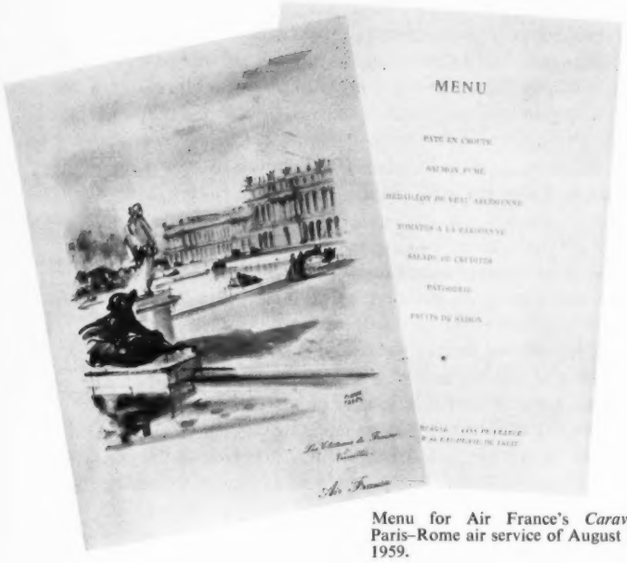
Aboard the *Caravelle* the Air France hostess uses a trolley to take her trays down the gangway to serve her 50 tourist class passengers in two trips.

American service French style: A "cabin service simulator" has been set up in Maxim's restaurant in Paris to train PAA's cabin crews. Left: the manager of the Hôtel George V, Paris; centre: the wife of Maxim's owner.

New World fashion, American Airlines organized an efficient system. Where there were formerly eight liquid containers across the buffet, holding coffee, iced water, soup, etc., the galley now has only one small unit. The hostess simply presses a button, the rest is automatic.

Gourmets need have no fears

This statement of the hard facts confronting jet-age *cuisine* is not in any way intended to frighten the airborne epicure. For the time being, at any rate, meals will continue to be valiantly served and heartily eaten on most world routes, whether short or long.



Menu for Air France's *Caravelle* Paris–Rome air service of August 1st, 1959.

A glance at, say, Air France's menu for the Paris—Rome *Caravelle* flight of August 1st, 1959 — "*Pâté en Croûte, Saumon Fumé, Médaillon de Veau Arlésienne, Tomates à la Parisienne, Salade de Crudités, Pâtisserie, Fruits de Saison ... Apéritifs, Champagne, Vins de France, Cognac, Liqueur, Eau de Vie*"—is enough to show that passengers are not likely to faint from hunger; and on subsonic jet flights across the Atlantic, there is still time for them to consume Gargantuan meals at their leisure.

Pan American World Airways' catering service has calculated how long it takes to eat a Jet Clipper meal in terms of miles and speed. The answer: about 1,800 miles at 575 m.p.h., from first bite to last sip. Starting from New York, the Jet Clipper is over Boston when the cocktails are in the shaker and the *canapés* on the tray. Over Nova Scotia the passenger is spooning his *consommé* or spearing his shrimp cocktail. Pastry and fruit are served off the south tip of Greenland. Coffee, cognac, a short nap ... and Paris or London is only two or three hours away.

The word "cocktails"—to decline them is difficult, to drink them is dangerous, as André Maurois says—brings us, of course, to American catering in general.

As Americans are not presumptuous, Pan American recognizes the superiority of French *cuisine* without envy. The airline's *cuisine*, according to Kenneth Parratt, Director of the Passenger Service, "is international in character with the universally accepted French accent in preparation."

This principle has resulted in the "marriage" of PAA and Maxim's of Paris. The world-famed restaurant provides the airline with its sixty

"I'm sorry, but you've left something out of your mayonnaise." PAA employs 52 people in its Idlewild kitchens, which have their own radio telephone and teleprinter installations for communicating with aircraft, vehicles and the air traffic control centre.

The dishes on Japan Air Lines' menu are quite intelligible to western readers.

Sandwiches being prepared in Japan Air Lines' Tokyo kitchens.

years of experience in catering to gourmets from all over the world, and PAA supplies the latest technological improvements in food preservation and distribution.

In more precise terms, Maxim's has taken over the training of PAA's cabin crews and has set up, in one of the rooms of its Paris establishment, a "cabin service simulator", illustrated in these pages.

Problem No. 1: fresh food supplies

As has been said, America has taken a leaf from Europe's cookery book; the Europeans, however, are themselves learning much from American food preservation and transport techniques.

"Naturally," say Air France catering officials with a sigh, "we should prefer to serve nothing but freshly cooked meals, but . . ."

And this one word "but" covers a multitude of difficulties.

- *The number of passengers is legion.* In 1958 the giant Waldorf Astoria Hotel in New York served about 3 million meals; PAA, on the other hand, served 4,380,000 and Air France 2,632,000. The following table, which shows Air France's catering statistics over five years, gives some idea of the flood-tide growth of airborne catering services.

Galley of a KLM DC-7C.

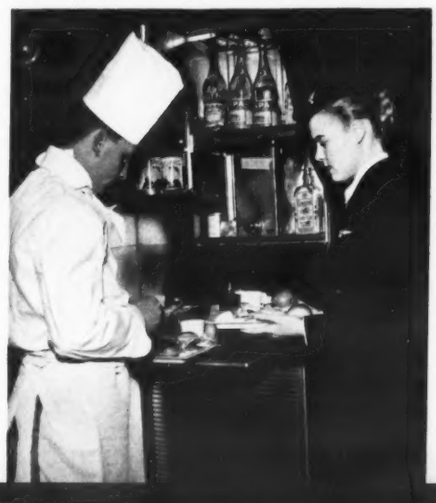
Growth of Air France's Catering Service

	Hot Meals	Cold Meals	Miscellaneous Meals	Total
1953	128,000	503,000	623,000	1,254,000
1955	382,000	621,000	1,014,000	2,017,000
1958	742,000	556,000	1,334,000	2,632,000

- *The number of passengers carried by each aircraft is steadily increasing.* In 1950 a Lockheed *Constellation* could carry about 50 passengers across the Atlantic; today, in 1959, the Boeing 707 will take up to 140. But even a *Super Constellation G* will take up to 80 passengers, for whom, in the case of Lufthansa, one steward is provided in the galley and two hostesses in the cabin. "When it is considered," says Lufthansa, "that these 80 passengers are crossing the Atlantic in three classes, each of which is served with different food, it will readily be admitted that this task can be performed only by highly-trained personnel whose every movement is timed to the split second. It is also essential to load the meals onto the aircraft ready prepared."

Hors d'œuvre on a BOAC *Comet 4*.

Don't be misled... Sabena carries not only mineral waters, but also a plentiful stock of stronger beverages (in the cupboard behind the hostess, who will certainly look after her passengers well).



"What is more," says Air France, "the galley space has remained practically the same as before." A whole battery of equipment has to be squeezed into this tiny space: refrigerators for food and bottles, electric hotplates etc., not to mention kitchen utensils, crockery, cutlery and linen. On its South American services Air France carries nearly 2,000 lb. of serving equipment per aircraft. The Swissair administration of Zurich/Kloten airport distributed about 350,000 lb. of linen in 1958 and expects this amount to be increased to over 1,140,000 lb. by 1970. Where, under these circumstances, is the room to be found for extra equipment, if fresh food is to be served all or most of the time?

• *One last snag: In many regions of the world, such as the Middle East and Africa, it is impossible to find fresh food of the desired quality or kind.* "Just try buying beef or veal in Pakistan or India," says the head of Air France's catering service. "And bear in mind, when you sally forth with your shopping basket, that the butchers in Karachi are shut for three days in the week."

In other words, when it comes to preparing main meals, there are three possibilities, on which Lufthansa's catering service reports as follows:

1. *Transportable ovens for short and medium stages.* Meals are freshly prepared in the airport kitchen and put hot into transportable ovens which, when connected up with the aircraft's electrical system, will enable them to be served immediately after take-off. With this method is should be remembered that not all foods can remain in a hot oven for two hours without their appearance or flavour being spoiled. Fried potatoes, for example, will not stand even as much as an hour in the oven.

2. *Refrigerated meals.* Freshly-prepared meals are refrigerated to last for a limited time, are taken aboard long-range aircraft and heated by air circulating in an oven. They must, however, be eaten after two hours at the latest.

3. *Deep-frozen meals.* Lufthansa's cooks were at first highly sceptical of this way of treating food, little known in Germany. They shuddered at the thought of taking fillet steak or tender veal, half-grilling it, deep-freezing it to −50°F, storing it at 0°F for weeks or months, and heating it to 450 or 540°F so as to obtain fresh and appetizing dishes. Then the food chemists of the Stuttgart Institute of Domestic Science joined the fray, pointing out that when the provisions of the Scott Antarctic Expedition were found after 50 years, they were still completely fresh.

Today Lufthansa's cooks are as familiar with deep freezing as they are with boiling eggs. Of course, not all foods can be deep-frozen, and it is above all important *to keep the freezing and thawing processes as short as possible.* The aircraft ovens are fitted with time switches which can be set to the time required to thaw and cook each meal. A grilled chicken takes just 22 minutes to turn from a block of ice to a tempting dish. So much for deep freezing. Over certain stages where time is short, however, cold meals are the only way of allowing passengers enough time to eat and enabling the hostesses to remove the crockery and cutlery to the galley before landing.

Food requirements across the world

It is difficult, say the caterers, to include the favourite dishes of individual nations in the menus of international services. In world aviation the language of communication is English, that of the stomach is French—tasty, light, digestible dishes.

Food being prepared at Swissair. The Swiss have a particular knack for preparing cold dishes.

The youngest generation of passengers is not neglected. Above: baby foods and milk-bottle coolers on an American Airlines aircraft: below: a contented passenger.

Children's menu on Lufthansa's *Senator* trans-Atlantic service.

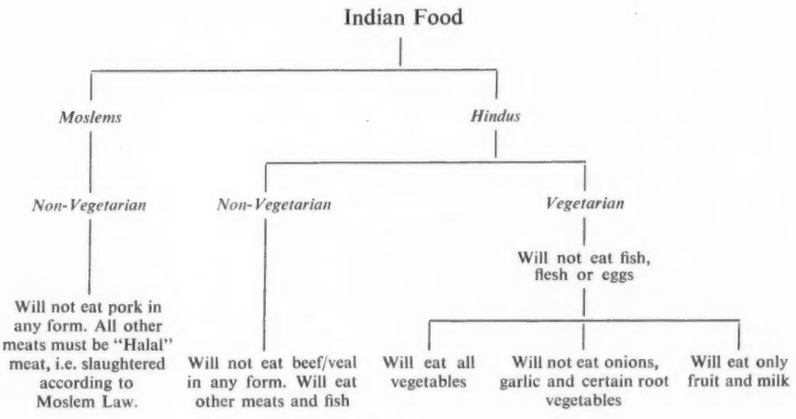
Air-India International's young passengers also get special food.

A special PAA kosher table service: "... all dishes and silverware on this tray are brand-new and have never been used before," says the card in the middle of the tray.

◁ Air-India gives vegetarians rice, vegetable curry and yoghourt.

That is all very well, but in certain regions and with certain nations this magic formula will not work. Even on scheduled Atlantic flights many different requirements must be met: special diets (salt-free, sugarless, unspiced etc.), food for religious groups such as Catholics, Jews, or Moslems.
On certain Pacific and Middle or Far Eastern routes, however, the exceptions become the rule, and European menus disappear into the galley cupboard.
On PAA's "typically Moslem" routes the menu looks something like this: *Breakfast*—"Roti" (pancakes) and boiled eggs; *Lunch*—Vegetable curry with rice, tomato chutney and rice pudding; *Supper*—Chicken curry with rice, mango chutney and rice pudding. Rice, rice and rice again. For passengers still farther east knives and forks are, of course, replaced by chopsticks.
BOAC not only serves Far Eastern menus, but supplements its British cabin crews by Chinese, Japanese, Indian, or Pakistani hostesses to make its eastern passengers feel at home.
But all this is child's play in comparison with Air-India International's catering problems. Some Hindus are vegetarians, other eat meat. Those who eat meat eat different kinds from the Moslems. So complicated is the system that Air-India could represent it only in the form of a table which is reproduced for the benefit of readers. But this table, says Air-India is by no means complete. Apart from the two main religions there are countless sects with their own rules for eating. A Sikh, for instance, would be mortally offended if offered any meat other than mutton or poultry slaughtered according to his own religious rites. In addition there are geographical peculiarities; wheat is the staple food in the north, rice in the south.
This, then, is a brief glimpse into the mysteries of the airline catering services. And there are a thousand and one difficulties which have not even been touched. For instance, "tummy time" does not always coincide with time by the clock. There are foods which, in spite of pressurized cabins, become "airsick" at modern flight altitudes (particularly "airminded" foods, says Air France, are *Coq au Chambertin* and *Canard à l'Orange*). In spite of intensive training, language difficulties can arise between cabin crews and passengers. One of Lufthansa's dishes, for example, owes its creation to a mistake. "Tell me, my lad," a VIP asked a youthful steward, "what are *crêpes Suzette?*" — "Pancakes with ice cream, sir," answered the steward, with the courage born of ignorance. When the steward in the galley heard this a chill ran down his spine, but he prepared the *crêpes Suzette* with the courage born of despair, wrapped them round some vanilla ice and poured hot chocolate sauce over them ... If ever you fly by the German airline, be sure to ask for *Crêpes Suzette à la Lufthansa.*
But despite all difficulties of temperature, pressure, diet and language, the union of the newest means of transport with the ancient art of cookery is by no means an unhappy one.

"Auf Wiedersehen!" smiles Edmund Dittler, who rules Lufthansa's kitchens with a rod of iron.


Indian Food
Moslems
Hindus
Non-Vegetarian
Non-Vegetarian
Vegetarian
Will not eat fish, flesh or eggs
Will not eat pork in any form. All other meats must be "Halal" meat, i.e. slaughtered according to Moslem Law.
Will not eat beef/veal in any form. Will eat other meats and fish
Will eat all vegetables
Will not eat onions, garlic and certain root vegetables
Will eat only fruit and milk

PILLARS OF WORLD AIR TRANSPORT

A "Who's Who" of the International Air Transport Association

(as at the beginning of July 1959)

To celebrate the fortieth year of its existence the International Air Transport Association will have the round number of 90 member companies at its 15th Annual General Meeting, to be held in the Imperial Hotel, Tokyo, between October 12th and 16th, 1959. Of these 90 companies, 80 operate international services and qualify for the rank of active members, whereas the ten purely domestic carriers are listed as associate members.

In the past twelve months the Association has welcomed two new active members —Ethiopian Air Lines, of Addis Ababa, and Sudan Airways, of Khartoum—and two associates—Hawaiian Airlines, of Honolulu, and South West Air Transport, of Windhoek, South-West Africa.

The combined fleets of all IATA members total more than 3,200 aircraft of all classes, and their operating statistics for 1958 showed the following increases over the previous year: 69.3 million passengers (+ 7.3 percent), 807.8 million freight ton-miles (+ 21.5 percent), 266.6 million mail ton-miles (+ 10.3 percent).

*

As for the arrangement of this year's table, the first column, "Capital or Ownership", has been replaced by information on revenue ton-miles and number of revenue passengers carried in 1958, as this gives a clearer indication of the extent of the companies' activities.

Misrair, of Cairo, has been placed, not under the heading "Africa", as last year, but, in view of the creation of the United Arab Republic, under "Near and Far East".

Editors.

1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
EUROPE					
AER LINGUS TEORANTA, 43, Upper O'Connell Street, Dublin, Eire.					
a) 10,932 t/mi 17,593 t/km b) 450	P. Lynch, Chairman J. F. Dempsey, General Manager Capt. J. C. Kelly-Rogers, Deputy General Manager	10 Vickers Viscount 7 Fokker F.27 5 Douglas DC-3	—	Dublin to 11 points in Europe, 11 points in Britain, Dublin-Shannon	7,855 mi 12,640 km 1,905
AERLINTE EIREANN (IRISH AIR LINES), 43, Upper O'Connell Street, Dublin, Eire.					
a) 3,350 t/mi 5,390 t/km b) 12	J. F. Dempsey, General Manager Capt. J. C. Kelly-Rogers, Deputy General Manager	3 Lockheed 1049H (leased)	3 Boeing 720	Dublin to New York and Boston	3,072 mi 4,944 km 39 (N.B.: Aer Lingus staff also act on behalf of Airlinte Eireann)
AIR FRANCE, 2, rue Marbeuf, Paris 8e, France.					
a) 243,400 t/mi 407,890 t/km b) 2,517	Max Hymans, Chairman Louis Lesieur, Managing Director Maurice Lemoine, Dep. Managing Director, Secretary-General Raymond Dupré, Dep. Managing Director (Engineering) Robert Montarnal, Dep. Managing Director (Economic Affairs)	5 Sud-Aviation Caravelle 10 Lockheed 1649 22 Lockheed 1049 15 Lockheed 749 11 Vickers Viscount 12 Breguet Provence 24 Douglas DC-4 36 Douglas DC-3	19 Sud-Aviation Caravelle 17 Boeing 707	Paris to 38 points in Europe, 133 in Africa, 20 in the Americas, 13 in Asia	187,650 mi 302,000 km 20,579
AIRWORK LTD., Airwork House, 35, Piccadilly, London, W.1, England.					
a) 16,293 t/mi 26,221 t/km b) 37.5	M. D. N. Wyatt, Chairman and Managing Director W. K. Davison, General Manager G. E. Ford, Operations Manager K. R. Sangster, Traffic Manager L. R. E. Castlemaine, Sales Manager	5 Vickers Viscount 2 Bristol Britannia 9 Bristol Super-freighter 3 Douglas DC-4 8 Douglas DC-3	—	To points in East, West and Central Africa and the Far East	28,163 mi 45,324 km 477
ALITALIA, Viale Maresciallo Pilsudski 92, Rome, Italy.					
a) 51,159 t/mi 82,333 t/km b) 657.1	Count Nicolò Carandini, President Gen. Aldo Urbani, Vice-President Lord Douglas of Kirtleside, Vice-President Ing. Bruno Velani, Managing Director	10 Vickers Viscount 6 Douglas DC-7C 11 Douglas DC-6B 12 Douglas DC-3 6 Convair 440	4 Douglas DC-8	North and South America, North, South, East and Central Africa, Near East, Europe; domestic to 14 points	58,032 mi 93,394 km 4,074
AUSTRIAN AIRLINES, Salesianer Gasse 1, Vienna III, Austria.					
a) 2,083 t/mi 3,353 t/km b) 37	Sepp Froeschl, Manager Rudolf Trimmel, Manager	4 Vickers Viscount (Fred Olsen)	—	Vienna to 13 points in Eastern and Western Europe	6,200 mi 10,000 km 285
AVIACO, AVIACIÓN Y COMERCIO S.A., Aduana 33, Madrid, Spain.					
a) 4,305.4 t/mi 6,928.8 t/km b) 185.5	Emilio Gil Cácho, Managing Director José Inchausti Balseiro, General Manager	1 Convair 440 3 Bristol Freighter 10 others	2 Convair 440	Domestic; points in North Africa; Lisbon; Marseilles; Brussels	9,266 mi 14,912 km 712
B.E.A., BRITISH EUROPEAN AIRWAYS, Keyline House, South Ruislip, Middlesex, England.					
a) 96,320 t/mi 155,012 t/km b) 2,760	Marshal of the Royal Air Force Lord Douglas of Kirtleside, Chairman Sir John Keeling, Deputy Chairman Anthony H. Milward, Chief Executive	64 Vickers Viscount 41 Douglas DC-3 2 D.H. Heron 3 D.H.89 5 helicopters	7 D.H. Comet 4B 20 Vickers Vanguard 24 D.H.121	International to 53 points in Europe and Near East; domestic to 22 points	40,000 mi 64,500 km 11,485
B.O.A.C., BRITISH OVERSEAS AIRWAYS CORPORATION, London Airport, Hounslow, Middlesex, England.					
a) 127,860.6 t/mi 205,766.6 t/km b) 465.3	Sir Gerard d'Erlanger, Chairman Sir George Cribbett, Deputy Chairman Basil Smallpeice, Managing Director Keith Granville, Deputy Managing Director	15 D.H. Comet 4 32 Bristol Britannia 10 Douglas DC-7C 2 Boeing Stratocruiser 2 Canadair Argonaut	15 Boeing 707 4 D.H. Comet 4 35 Vickers VC.10	To points in Europe; Africa; North America; Central America and the Caribbean; Asia; Australasia	76,894 mi 123,749 km 19,035
C.S.A., ČESKOSLOVENSKÉ AEROLINIE, Námesti Republiky 655/8, Prague I, Czechoslovakia.					
a) 6,551 t/mi 10,543 t/km b) 6,024	Josef Procházka, Director General Alois Palichleb, Director of Operations Oldřich Holovsky, Technical Director Jan Barcal, Commercial Director	3 Tupolev Tu-104A 25 Ilyushin Il-14 6 Ilyushin Il-12 6 Douglas DC-3	—	London, Paris, Vienna, Helsinki, Zurich, Brussels, Amsterdam, Cairo; Eastern Europe, incl. Moscow	10,754 mi 17,308 km 1,707

1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
***CYPRUS AIRWAYS LIMITED,** 16, Byron Avenue, Nicosia, Cyprus.					
a) n.a. b) n.a.	Dr. C. Raeburn, Chairman P. Holroyd Smith, General Manager	Services operated by BEA Viscount aircraft	—	Near and Middle East; Greece; connections to U.K.	2,674 mi 4,303 km 80
DEUTSCHE LUFTHANSA AG., Claudiusstrasse 1, Cologne, Germany.					
a) 97,740 t/mi 157,300 t/km b) 622	Hans M. Bongers, Commercial Director Gerhard Höltje, Technical Director	9 Vickers Viscount 4 Lockheed 1649 7 Lockheed 1049G 9 Convair 440 3 Douglas DC-3	4 Boeing 707	North Atlantic, South Atlantic, Near East, Europe, domestic	51,600 mi 83,000 km 6,040
K.L.M., ROYAL DUTCH AIRLINES, 1, Plesmanweg, The Hague, Netherlands.					
a) 165,350 t/mi 266,100 t/km b) 941	I. A. Aler, President Ir. F. Besançon, Executive V.P. (Production) Dr. L. H. Slotemaker, Executive V.P. (Air Policy) Dr. J. van der Wiel, Executive V.P.	9 Vickers Viscount 18 Lockheed 1049E/G/H 10 Lockheed 749A 15 Douglas DC-7C 13 Douglas DC-6/6B 13 Douglas DC-3C 13 Convair 240/340	2 Fokker F.27 12 Lockheed Electra 12 Douglas DC-8	Europe; Middle and Far East; Australia; USA; Canada; South America and Mexico; Caribbean; Africa	168,000 mi 270,400 km 16,863
EAGLE AIRWAYS LTD., Marble Arch House Air Terminal, Edgware Road, London, W. 2, England.					
a) 1,224 t/mi 1,969 t/km b) 22	H. Bamberg, Chairman and Managing Director M. A. Guinane, Deputy Managing Director J. H. Sauvage, Operations Manager	3 Douglas DC-6C 10 Vickers Viking	—	London to 9 points in Europe; Manchester to 2 points in Europe; Birmingham to 1 point in Europe	5,369 mi 8,641 km 491
FINNAIR, AERO O/Y, Töölönkatu 4, Helsinki, Finland.					
a) 10,143 t/mi 16,323 t/km b) 395	L. Grandell, President B. Aulin, Vice-President (Technical) M. Mannio, Vice-President (Traffic and Sales) K. J. Temmes, Vice-President (Operations)	6 Convair 340/440 10 Douglas DC-3	3 Sud-Aviation Caravelle	Domestic; Europe, including Moscow	10,795 mi 17,372 km 1,184
FLUGFELAG ISLANDS (ICELANDAIR), Reykjavik Airport, P.O. Box 955, Reykjavik, Iceland.					
a) 3,052 t/mi 4,915 t/km b) 69	G. Vilhjálmsson, Chairman O. O. Johnson, General Manager S. Matthiasson, Secretary	2 Vickers Viscount 1 Douglas DC-4 3 Douglas DC-3 1 flying-boat	—	Reykjavik to U.K., Scandinavia and Germany; domestic	6,082 mi 9,788 km 200
HUNTING-CLAN AIR TRANSPORT LTD., London Airport, Hounslow, Middlesex, England.					
a) 11,002 t/mi 17,707 t/km b) 44.8	M. H. Curtis, Managing Director Capt. L. B. Greensted, Operations Director D. J. Platt, Commercial/Sales Manager	2 Bristol Britannia 3 Vickers Viscount 2 Douglas DC-6C 5 Douglas DC-3 7 Vickers Viking	—	To East, West, Central Africa and Gibraltar	15,293 mi 24,612 km 368
IBERIA, LÍNEAS AÉREAS DE ESPAÑA S.A., Avenida América, 2, Madrid, Spain.					
a) 56,952 t/mi 91,655 t/km b) 749	Tomás Delgado, President César Gómez Lucía, General Manager Juan Viniegra Velasco, Secretary-General	5 Lockheed 1049G 5 Convair 440 7 Douglas DC-4 14 Douglas DC-3 4 Bristol 170	—	To New York; points in Latin America; Africa; Europe; domestic	33,550 mi 53,993 km n.a.
J.A.T., JUGOSLOVENSKI AEROTRANSPORT, Bircaninova 1/III, Belgrade, Yugoslavia.					
a) 3,472 t/mi 5,588 t/km b) 128	Milan Simović, General Director Gojko Vojvodić, Commercial Director Voislav Rakić, Traffic Director	6 Ilyushin Il-14 2 Douglas DC-6B 13 Douglas DC-3 3 Convair 340/440	—	To eight European countries; Egypt; domestic	7,160 mi 11,523 km 897
*** L.O.T., POLSKIE LINIE LOTNICZE,** ul. Hoza, 39, Warsaw, Poland.					
a) n.a. b) 40	J. Krzywicki, General Manager W. Leia, Technical Manager A. Wojnowski, Commercial Manager M. Grabowski, Operations Manager	11 Ilyushin Il-14 12 Ilyushin Il-12 20 Livotchkin Li-2 3 Convair 240 5 Douglas DC-3	Ilyushin Il-14P	Domestic; 15 points in Eastern and Western Europe	7,752 mi 12,475 km n.a.
OLYMPIC AIRWAYS S.A., 6, Othonos Street, Athens, Greece.					
a) 7,661 t/mi 12,392 t/km b) 315	S. Damaskinos, General Manager C. Danis, Technical Manager C. Chondros, Operations Manager	5 Douglas DC-6/6B 2 Douglas DC-4 14 Douglas DC-3	2 Douglas DC-8 2 D.H. Comet 4B	Middle East and Turkey; five European countries; domestic	8,785 mi 14,138 km 1,219
SABENA, 35, rue Cardinal Mercier, Brussels, Belgium.					
a) 99,917.4 t/mi 160,801.3 t/km b) 954	Gilbert Périer, Chairman Gaston Claeys, Managing Director Wilhelm Deswarte, General Manager Gaston Dieu, Assistant General Manager Félicien Pirson, Technical Manager Anselme Vernieuwe, Operations Manager	9 Douglas DC-7C 13 Douglas DC-6/A/B 10 Douglas DC-4 28 Douglas DC-3 11 Convair 440 10 helicopters	5 Boeing 707	Points in Europe and Mediterranean; North Atlantic; Belgian Congo and South Africa; domestic in Belgian Congo	130,500 mi 210,000 km 10,963
S.A.S., SCANDINAVIAN AIRLINES SYSTEM, Bromma Airport, Stockholm, Sweden.					
a) 126,200 t/mi 203,100 t/km b) 1,520	Åke Rusck, President Viggo J. Rasmussen, Executive Vice-President Thore Boye, Executive Vice-President Nils Langhelle, Executive Vice-President	4 Sud-Aviation Caravelle 20 Convair 440 14 Douglas DC-7C 22 Douglas DC-6/6B	7 Douglas DC-8 12 Sud-Aviation Caravelle	Points in Europe; North and South Atlantic; polar routes Europe-Greenland-U.S. West Coast and Europe-Alaska-Japan; Middle, Near and Far East; Africa	129,902 mi 209,054 km 12,233
SKYWAYS LIMITED, 7, Berkeley Street, London, W. 1, England.					
a) n.a. b) n.a.	Sir Wavell Wakefield, Chairman E. Rylands, Managing Director Capt. J. Michie, Operations Manager	3 Lockheed 749A 10 Avro York 6 Douglas DC-3 8 H.P. Hermes IV	—	London to Tunis, Malta, Cyprus, France	n.a. n.a.
SWISSAIR TRANSPORT COMPANY LIMITED, Hirschengraben 84, Zurich, Switzerland.					
a) 127,213 t/mi 204,730 t/km b) 1,062.4	Ernst Schmidheiny, Chairman Walter Berchtold, Managing Director Eugen Groh, Director of Finance Lucien Léon Ambord, Director of Traffic & Sales Robert Fretz, Director of Operations Isidor Lack, Director of Engineering Armin Baltensweiler, Director of Planning Dr. Heinz Haas, Secretary-General	5 Douglas DC-7C 8 Douglas DC-6A/B 11 Convair 440 8 Douglas DC-3	3 Douglas DC-8 5 Convair 880	Points in Europe, North and South America, Near and Far East	75,200 mi 121,000 km 5,429

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1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
T.A.I., TRANSPORTS AÉRIENS INTERCONTINENTAUX, 23, rue de la Paix, Paris, 2e, France.					
a) 26,116 t/mi 42,029 t/km b) 75	* Paul Bernard, Chairman General Georges Fayet, General Manager J. J. Wilmot-Roussel, Assistant General Manager Colonel L. Aubrée, Operations Manager	3 Douglas DC-7C 5 Douglas DC-6/6B 2 Douglas DC-4 4 Douglas DC-3	2 Douglas DC-8	To points in Morocco, French Africa, Madagascar, Greece, Middle East, Vietnam, Australia, New Zealand, New Caledonia, French Pacific Islands	51,250 mi 82,478 km 1,276
T.A.P., TRANSPORTES AÉREOS PORTUGUESES SARL, rua Braamcamp 2, Lisbon, Portugal.					
a) 8,495 t/mi 13,671 t/km b) 65.2	Alfredo V. Pinto, President Duarte Calheiros, Managing Director	3 Lockheed 1049G 3 Douglas DC-4	—	Portuguese African provinces, points in Europe and North Africa	10,020 mi 16,120 km 1,009
T.H.Y., TÜRK HAVA YOLLARI A.O., Cankiri Caddesi 88, Ankara, Turkey.					
a) 9,540 t/mi 15,353 t/km b) 395	Ulvi Yenal, General Manager Hüseyin Ünsal, Assistant General Manager Captain A. Spooner, Operations Manager	4 Vickers Viscount 21 Douglas DC-3 7 D.H. Heron	—	Domestic: Athens, Nicosia, Beirut, Rome	10,446 mi 16,813 km 1,420
U.A.T., UNION AÉROMARITIME DE TRANSPORT, 5, bd Malesherbes, Paris 8e, France.					
a) 35,672 t/mi 57,408.3 t/km b) 189.5	Louis Pommery, Chairman and Managing Director Jean Combard, Director Roger Loubry, Director	10 Douglas DC-6B 1 Douglas DC-4 6 Nord Noratlas 7 D.H. Heron	2 Douglas DC-8	To points in French West Africa; French Equatorial Africa; South Africa; Libya; local African services	76,000 mi 122,280 km 2,500

U.S.A. AND CANADA

AMERICAN AIRLINES, 100, Park Avenue, New York, N.Y., USA.					
a) 549,908 t/mi 884,991 t/km b) 7,792	C. R. Smith, President C. W. Jacob, Senior Vice-President and Secretary O. M. Mosier, Executive Vice-President (Operations)	16 Boeing 707 16 Lockheed Electra 33 Douglas DC-7 81 Douglas DC-6/6AF 46 Convair 240	34 Boeing 707 18 Lockheed Electra 25 Convair 600	U.S. transcontinental to 23 states and District of Columbia; Canada; Mexico	14,938 mi 24,041 km 21,461
BRANIFF INTERNATIONAL AIRWAYS, INC., Exchange Park, Dallas 35, Texas, USA.					
a) 110,147 t/mi 177,265 t/km b) 2,136	Fred Jones, Chairman William A. Blakley, Chairman, Executive Committee Charles E. Beard, President J. W. Miller, Executive Vice-President	3 Lockheed Electra 6 Douglas DC-7C 10 Douglas DC-6 10 Douglas DC-3 2 Lockheed 049 31 Convair 340/440 2 Curtiss C-46	5 Boeing 707 6 Lockheed Electra	Points in central USA; Texas points to Washington and New York; West Coast services to South America	15,500 mi 24,900 km 5,100
****CHICAGO HELICOPTER AIRWAYS**, 5240, West 63rd Street, Chicago, 38, Illinois, USA.					
a) 129 t/mi 207 t/km b) 108	John S. Gleason, Jr., President and Treasurer C. W. Moore, Executive Vice-President	6 Sikorsky S-58C 5 Bell B47-G	3 Sikorsky S-61	Local helicopter services	340 mi 550 km 150
C.P.A., CANADIAN PACIFIC AIR LINES LTD., Vancouver Airport, British Columbia, Canada.					
a) 43,690 t/mi 70,312 t/km b) 250	G. W. G. McConachie, President R. W. Ryan, Executive Vice-President H. B. Renwick, Vice-President (Traffic) R. B Phillips, Vice-President (Administration) H.D. Cameron, General Manager (Operations)	8 Bristol Britannia 15 Douglas DC-6A/B 5 Convair 240 6 Douglas DC-3 2 others	—	To Far East, Australia, South America, Mexico, Europe; domestic	45,038 mi 72,481 km 2,836
DELTA AIR LINES, INC., Atlanta Airport, Atlanta, Ga., USA.					
a) 165,071 t/mi 265,651 t/km b) 2,825.6	R. W. Freeman, Chairman C. E. Woolman, President and General Manager	21 Douglas DC-7/7B 7 Douglas DC-6 12 Douglas DC-3 28 Convair 340/440 4 Lockheed 749 5 Curtiss C-46	6 Douglas DC-8 10 Convair 880	U.S. domestic, New York, Chicago and Detroit to South and West; to points in Caribbean area, Caracas	11,379 mi 18,313 km 6,317
E.A.L., EASTERN AIR LINES, INC., Eastern Air Lines Building, 10, Rockefeller Plaza, New York 20, N.Y., USA.					
a) n.a. b) 8,065	E. V. Rickenbacker, Chairman Thomas F. Armstrong, President Capt. John H. Halliburton, Senior Vice-President (Operations)	40 Lockheed Electra 48 Douglas DC-7B 18 Lockheed 749 38 Lockheed 1049/C/G 56 Martin 4-0-4 20 Convair 440 7 Douglas DC-6B (on lease) 1 Douglas DC-4	16 Douglas DC-8	Domestic, mostly north-south in eastern USA; Puerto Rico, Montreal, Bermuda	18,352 mi 29,534 km 16,000
****THE FLYING TIGER LINE, INC.**, Lockheed Air Terminal, Burbank, Calif., USA.					
a) 141,255.5 t/mi 227,330.3 t/km b) —	Samuel B. Mosher, Chairman Robert W. Prescott, President Fred Benninger, Executive Vice-President Frank Lynott, Vice-President (Operations)	14 Lockheed 1049H 5 Curtiss C-46	10 Canadair CL-44D-4	World-wide cargo	30,815 mi 49,592 km 1,480
**** HAWAIIAN AIRLINES**, Honolulu International Airport, Honolulu, Hawaii.					
a) 917.3 t/mi 1,476.3 t/km b) n.a.	Stanley C. Kennedy, Chairman Arthur D. Lewis, President and Chief Executive Officer Lionel M. Machado, Vice-President (Operations)	7 Convair 340/440 1 Douglas DC-6A/B 7 Douglas DC-3	—	Honolulu to Hilo and Kauai	412 mi 663 km n.a.
NATIONAL AIRLINES, INC., P.O. Box NAL, International Airport, Miami, Fla. USA.					
a) 115,923 t/mi 186,410 t/km b) 1,660.5	G. T. Baker, President J. C. Brawner, Executive Vice-President Walter Sternberg, Senior Vice-President (Market Development) A. G. Hardy, Senior Vice-President (Washington) J. M. Rosenthal, Senior Vice-President (Industrial Relations)	5 Lockheed Electra 4 Lockheed 1049H 17 Convair 340/440 8 Douglas DC-7/7B 12 Douglas DC-6/6B	18 Lockheed Electra 3 Douglas DC-8	U.S. East Coast, Boston via New York to Miami; Miami to Houston via New Orleans; foreign to Cuba	3,400 mi 5,470 km 4,500
****N.Y.A., NEW YORK AIRWAYS, INC.**, P.O. Box 426, La Guardia Airport, Flushing 71, New York, N.Y., USA.					
a) 198 t/mi 319 t/km b) 91	Robert L. Cummings, Jr., President Glen B. Eastburn, Vice-President	5 Vertol 44B 2 Bell 47J	5 Fairey Rotodyne	Helicopter feeder services in New York metropolitan area	183 mi 295 km 200
NORTHWEST AIRLINES, INC., 1885, University Avenue, St. Paul, Minnesota, USA.					
a) 185,447 t/mi 298,447 t/km b) 1,827	Croil Hunter, Chairman Donald W. Nyrop, President	*4 Lockheed Electra 8 Douglas DC-7C 17 Douglas DC-6B 14 Douglas DC-4 9 Boeing Stratocruiser 12 others	6 Lockheed Electra 5 Douglas DC-8	New York and Washington to Seattle; to Hawaii, Canada, Alaska and the Orient	19,000 mi 30,600 km 6,496

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1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
PANAGRA, PAN AMERICAN GRACE AIRWAYS, INC., 135, East 42nd Street, New York, 17, N.Y., USA.					
a) 23,884 t/mi 38,438 t/km b) 128.8	Andrew B. Shea, President Douglas Campbell, V.P. & General Manager Thomas J. Kirkland, V.P. (Operations) Ludwig H. Clifton, V.P. & Comptroller Cyrus S. Collins, V.P. (Traffic & Sales)	6 Douglas DC-7B 4 Douglas DC-6B 2 Douglas DC-4 4 Douglas DC-3	4 Douglas-DC-8	Panama to Colombia, Ecuador, Peru, Bolivia, Chile and Argentina, with interchange arrangements to Miami, Washington and New York	5,344 mi 8,600 km 1,350
P.A.A., PAN AMERICAN WORLD AIRWAYS, 135, East 42nd Street, New York 17, N.Y., USA.					
a) 535,000 t/mi 861,000 t/km b) 2,899	Juan T. Trippe, President John C. Leslie, V.P. (Administration) Samuel F. Pryor, V.P. & Assistant to the President Henry J. Friendly, V.P. & General Counsel	6 Boeing 707 22 Boeing Stratocruiser 31 Douglas DC-7B/C 47 Douglas DC-6A/B 22 Douglas DC-4 3 Douglas DC-3 1 Douglas B-23	17 Boeing 707 12 Lockheed Super Hercules 21 Douglas DC-3	U.S. overseas; trans-Atlantic, trans-Pacific, Latin America, Far East, Australasia	69,924 mi 112,527 km 21,370
****QUEBECAIR**, Rimouski, Quebec, Canada.					
a) 1,883 t/mi 3,091.5 t/km b) 140.3	Roméo Crevier, President Aubert Brillant, Vice-President Maurice Tessier, Vice-President and Secretary	3 Fairchild F-27 6 Douglas DC-3 (1 leased) 1 Curtiss C-46 3 others	—	Domestic in Eastern Canada	2,125 mi 3,420 km 214
SEABOARD & WESTERN AIRLINES, INC., 80, Broad Street, New York 4, N.Y., USA.					
a) 21,036 t/mi 33,854 t/km b) —	Raymond A. Norden, President Arthur V. Norden, Exec. Vice-President & Treasurer Carl D. Brell, Vice-President (Operations)	9 Lockheed 1049E/H 3 Douglas DC-4 1 Douglas DC-3 1 Curtiss C-46	5 Canadair CL-44	Scheduled Atlantic cargo services to points in Europe	6,202 mi 9,981 km 1,009
T.C.A., TRANS-CANADA AIR LINES, International Aviation Building, Montreal, Canada					
a) 185,516 t/mi 298,557 t/km b) 2,785.5	G. R. McGregor, President H. W. Seagrim, V.P. (Operations) W. G. Wood, V.P. (Sales) W. S. Harvey, Comptroller	50 Vickers Viscount 13 Lockheed 1049 21 Canadair North Star 9 Douglas DC-3	6 Douglas DC-8 20 Vickers Vanguard	Trans-Atlantic to U.K., France, Germany, Switzerland, Austria; to USA; Caribbean; Bermuda; 38 points in Canada.	31,544 mi 50,765 km 10,043
* ****TRANS CARIBBEAN AIRWAYS**, 1451, Broadway, New York 19, N.Y., USA.					
a) n.a. b) n.a.	O. Roy Chalk, President Irving M. Buckley, Exec. Vice-President David J. McFarland, Director Traffic and Sales	3 Douglas DC-6/6A 1 Douglas DC-4 2 Curtiss C-46	1 Douglas DC-8	New York to San Juan, Puerto Rico	1,632 mi 2,626 km under 500
T.W.A., TRANS WORLD AIRLINES, INC., 380, Madison Avenue, New York 17, N.Y., USA.					
a) 514,289 t/mi 827,662 t/km b) 4,723	Warren Lee Pierson, Chairman Charles S. Thomas, President E. O. Cocke, Senior V.P. & System General Manager	15 Boeing 707 28 Lockheed 1649A 46 Lockheed 1049G 71 Lockheed 749 38 Martin 2-0-2/4-0-4 1 Douglas DC-4	Boeing 707 Convair 880	U.S. transcontinental domestic; trans-Atlantic to North and South Europe; Near and Middle East; to Manila, P.I.	50,000 mi 80,500 km 19,200
UNITED AIR LINES, INC., 5959, South Cicero Avenue, Chicago 38, Illinois, USA.					
a) 614,271 t/mi 988,573 t/km b) 7,276	W. A. Patterson, President J. A. Herlihy, Senior V.P. (Engineering and Maintenance) D. F. Magarrell, Senior V.P. (Transportation Services) D. R. Petty, Senior V.P. (Flight Operations) R. E. Johnson, Senior V.P. (Sales & Public Relations)	6 Douglas DC-8 55 Douglas DC-7 90 Douglas DC-6/A/B 47 Convair 340	34 Douglas DC-8 18 Boeing 720	Coast-to-coast in U.S.; Pacific coast from Mexican border to west Canada; overseas to Hawaii	14,000 mi 22,500 km 20,000

LATIN AMERICA

AEROLÍNEAS ARGENTINAS, Paseo Colón 185, Buenos Aires, Argentina.					
a) 35,079.8 t/mi 56,455.5 t/km b) 484.3	* Cmdr. Juan José Güiraldes, President Dr. Angel M. Lagomarsino, Vice-President Héctor Rodriguez, Commercial Manager Enrique D. Bermúdez, Technical Manager	3 D.H. Comet 4 5 Douglas DC-6 22 Douglas DC-3/4 4 Convair 240 10 others	3 D.H. Comet 4	Buenos Aires to New York and intermediate points; Buenos Aires to 6 points in Europe, 2 in Africa; services in South America	38,588 mi 62,102 km 5,971
AERONAVES DE MÉXICO S.A., Avenida Mariano Escobedo 491, Mexico City, Mexico.					
a) 23,433.3 t/mi 37,728.3 t/km b) 376,763	Tirso Carpizo, Executive Vice-President Jorge Pérez y Bouras, General Manager	2 Bristol Britannia 2 Lockheed 749 4 Convair 340 2 Douglas DC-4 12 Douglas DC-3	—	Domestic; La Paz, New York	7,825 mi 12,592 km 1,982
AVIANCA, AEROVÍAS NACIONALES DE COLOMBIA, 7, Carrera, 16—14, Bogotá, Colombia.					
a) 50,587 t/mi 81,411.5 t/km b) 1,123	Juan Pablo Ortega, President and Managing Director Sabas Pretelt, Executive Vice-President Rafael Barvo, Technical Vice-President	4 Lockheed 1049 3 Lockheed 749A 10 Douglas DC-4 31 Douglas DC-3 40 others	—	Domestic; Europe; Latin America; USA	26,109 mi 42,019 km 5,440
SERVIÇOS AÉREOS CRUZEIRO DO SUL S.A., 128, Avenida Rio Branco, Rio de Janeiro, Brazil.					
a) 10,163.4 t/mi 16,356.4 t/km b) 509.5	Dr. J. B. Ribeiro Dantas, President and Managing Director J. Q. Vieira de Carvalho, Commercial Director O. H. Müller, Operations Director	4 Convair 440 14 Convair 240/340 33 Douglas DC-3 7 Fairchild Packet	—	Domestic; South American international	25,763 mi 41,462 km 4,105
COMPAÑÍA CUBANA DE AVIACIÓN S.A., Aeropuerto Internacional "José Marti", Rancho Boyeros, Havana, Cuba.					
a) n.a. b) 337.4	G. T. Hermida, Chairman and Managing Director Capt. Oscar Madariaga, Operations Manager Oscar Bustillo, General Traffic and Sales Manager	4 Bristol Britannia 3 Lockheed 1049G 1 Lockheed 049 4 Vickers Viscount 6 Douglas DC-3	2 Boeing 707 3 Vickers Viscount	Domestic; to USA, Mexico, Portugal, Spain and Caribbean	10,690 mi 17,200 km 1,088
GUEST AEROVÍAS MÉXICO S.A., 51, paseo de la Reforma, Mexico City, Mexico.					
a) 5,307 t/mi 8,540 t/km b) 34.5	Winston Guest, President George L. Monteiro, Vice-President	3 Douglas DC-6 1 Douglas DC-4 2 Lockheed 749A	3 Lockheed 1049G	To Miami, Fla.; Caracas, Ven.; Miami–Bermuda–Lisbon–Madrid–Paris	9,958 mi 16,026 km 405
L.A.N., LÍNEA AÉREA NACIONAL - CHILE, Teatinos 384, Santiago de Chile, Chile.					
a) 16,560.2 t/mi 26,715.4 t/km b) 293.2	Mauricio Yánquez Illanes, President Héctor Sauvageot Ibarra, Commercial Manager Jorge Jarpa Reyes, Operations Manager	7 Douglas DC-6B 16 Douglas DC-3 4 Martin 2-0-2	—	Domestic; international in South America; Miami	8,160 mi 13,130 km 1,585

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1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
*** L.A.V., LÍNEA AEROPOSTAL VENEZOLANA**, Bloque 1, El Silencio, Caracas, Venezuela.					
a) n.a. b) n.a.	Héctor Font Viale-Rigo, President Enrique Chávez, Vice-President	8 Lockheed 749/1049 3 Vickers Viscount 30 Douglas DC-3 6 others	—	Domestic; South American international; USA; Portugal; Spain; Italy; West Indies	20,100 mi 32,350 km 1,819
P.A.B., PANAIR DO BRASIL S.A., Edificio Panair, Santos Dumont Airport, Rio de Janeiro, Brazil.					
a) 32,531 t/mi 52,354 t/km b) 323.3	Manoel F. Guimarães, Director President Cesar Pires de Mello, Director Superintendent Decio A. Vilhena, Operations Manager Harold P. Preston, Commercial Manager	4 Douglas DC-7C 4 Douglas DC-6C 12 Lockheed 749 5 flying-boats	4 Douglas DC-8	To European capitals, Near East; South America	53,757 mi 86,514 km 4,535
REAL S.A., TRANSPORTES AÉREOS, rua Conselheiro Crispiniano, 379, São Paulo, Brazil.					
a) 489,325 t/mi 787,491 t/km b) 2,011.3	Cmdr. Linneu Gomes, President Cmdr. Armando A. Campos, Operations Director Cmdr. Ary Flemming, Traffic Director (International Routes)	16 Convair 340/440 12 Curtiss C-46 69 Douglas DC-3	4 Convair 880 4 Convair 440	Domestic; international in South and Central America; Miami and Chicago	77,746 mi 125,120 km 6,705
VARIG, S.A., EMPRESA DE VIAÇÃO AÉREA RIO GRANDENSE, Av. Borges de Medeiros 410-16°, P.O. Box 243, Pôrto Alegre, RGS, Brazil.					
a) 14,640 t/mi 23,562 t/km b) 559	Rubem M. Berta, President Oscar Siebel, Deputy Manager Goetz G. Herzfeldt, Technical Director	5 Lockheed 1049 12 Convair 240 21 Douglas DC-3 14 Curtiss C-46	2 Boeing 707 2 Sud-Aviation Caravelle	Domestic; to New York; to Buenos Aires	18,129 mi 29,176 km 4,525

AFRICA

AIR ALGÉRIE, 46, Bd. Saint-Saëns, Algiers, Algeria.					
a) 4,539 t/mi 7,305 t/km b) 384	Jean Richard-Deshais, President & Managing Director Henri Alias, Director Jacques Soufflet, Director	2 Lockheed 749 3 Nord Noratlas 10 Douglas DC-4 3 Douglas DC-3	4 Sud-Aviation Caravelle	Algeria to Sahara, points in France, Switzerland, Balearic Islands	21,100 mi 33,900 km 1,036
C.A.A., CENTRAL AFRICAN AIRWAYS CORP., Salisbury Airport, Southern Rhodesia.					
a) 8,051 t/mi 12,957.1 t/km b) 158.8	M. Stuart-Shaw, General Manager R. P. Hartley, Assistant General Manager/Secretary K. H. Greager, Engineering Manager Capt. M. O'Donovan, Operations Manager	4 Vickers Viscount 5 Douglas DC-3 6 D.H. Beaver	—	To London; South Africa, Kenya, Tanganyika, Portuguese East Africa	12,403 mi 19,960 km 1,228
*** D.E.T.A., DIVISÃO DE EXPLORAÇÃO DOS TRANSPORTES AÉREOS**, rua Aranjo 103-20 Esq., Lourenço Marques, Mozambique.					
a) n.a. b) n.a.	A. H. Brazão de Freitas, Managing Director Abel Neves de Azevedo, Acting Manager	3 Douglas DC-3 3 Lockheed Lodestar 9 others	—	Lourenço Marques to South and Central Africa; domestic	3,500 mi 5,600 km 383
D.T.A., DIVISÃO DOS TRANSPORTES AÉREOS, Caixa Postal 79, Luanda, Angola.					
a) 1,092 t/mi 1,757 t/km b) 36.4	Pereira Leite, President J. da S. Medina, General Manager	7 Douglas DC-3 4 Beech D-18 3 D. H. Dragon Rapide	—	Portuguese West Africa domestic; French Equatorial Africa and Belgian Congo	6,080 mi 9,785 km 381
E.A.A.C., EAST AFRICAN AIRWAYS CORPORATION, Airways Terminal, Nairobi, Kenya.					
a) 5,008 t/mi 8,059 t/km b) 117	Sir Alfred Vincent, Chairman Lt.-Col. M. C. P. Mostert, General Manager A. E. Robinson, Chief Engineer Capt. E. E. Morris, Operations Manager	9 Douglas DC-3 4 D. H. Dominie 3 Canadair DC-4M	2 D. H. Comet 4	Domestic; to South Africa, U. K., India and Pakistan, Rhodesia and Nyasaland	23,001 mi 37,017 km 1,527
ETHIOPIAN AIR LINES INC., P.O. Box 1755, Addis Ababa, Ethiopia.					
a) 4,004 t/mi 6,443 t/km b) 92.7	H. E. Dedjazmatch Mengashia Seyoum, President and Chairman of the Board Victor H. Harrell, Jr., General Manager	3 Douglas DC-6B 16 Douglas DC-3 3 Convair 240 5 helicopters	—	To Khartoum, Cairo, Athens, Frankfurt; to Nairobi; international to neighbouring countries; domestic	9,782 mi 15,742 km 772
S.A.A., SOUTH AFRICAN AIRWAYS, Railway Headquarters, Johannesburg, South Africa.					
a) 29,147 t/mi 46,907 t/km b) 303	D. H. C. du Plessis, General Manager J. P. Hugo, Deputy General Manager J. G. Grove, Chief Executive J. D. T. Louw, Chief Airways Manager	4 Douglas DC-7B 7 Douglas DC-4 6 Douglas DC-3 7 Vickers Viscount 4 Lockheed 749	3 Boeing 707	Domestic; points in Africa, Australia; to European capitals	41,089 mi 66,126 km 2,605
**** SOUTH WEST AIR TRANSPORT (PTY.) LTD.**, P.O. Box 731, Windhoek, S.W.A.					
a) n.a. b) n.a.	P. H. M. du Plessis, Chairman G. T. van Rooyen, General Manager D. A. Hutchison, Commercial and Sales Manager	7 Ryan Navion 2 Piper Apache 6 Cessna 175/182	—	Domestic in South-West Africa	550 mi 885 km n.a.
*** W.A.A.C., WEST AFRICAN AIRWAYS CORP.**, P.O. Box 136, Lagos, Nigeria.					
a) n.a. b) n.a.	R. W. C. Baker-Beall, Chairman D. Malcolm-Brown, General Manager J. P. S. Bailey, Traffic Manager	5 Douglas DC-3 8 D. H. Heron 2 D. H. Dove 2 others	—	Nigerian domestic; Ghana domestic; to U.K. and Dakar	7,494 mi 12,060 km 1,455

NEAR AND FAR EAST

AIR CEYLON LTD., Hemas Building, York Street, Colombo 1, Ceylon.					
a) 3,000 t/mi 4,830 t/km b) 56	J. L. M. Fernando, General Manager F. G. A. van Moll, Deputy Gen. Man. Kenneth de Croos, Manager (Traffic & Sales)	1 Lockheed 1049G 2 Douglas DC-3	—	Domestic; to India & Pakistan, Middle East, Rome, London, Amsterdam; Singapore	8,977 mi 14,447 km 299
AIR INDIA INTERNATIONAL, New India Assurance Building, Mahatma Gandhi Rd., Bombay 1, India.					
a) 18,613.7 t/mi 29,988 t/km b) 88.3	J. R. D. Tata, Chairman B. R. Patel, Vice-Chairman & General Manager S. K. Kooka, Commercial Director A. C. Gazdar, Technical Director	10 Lockheed 1049 C/E/G 1 Douglas DC-3	3 Boeing 707	Domestic; Bombay to Europe, Africa, Japan & Australia	24,893 mi 40,061 km 4,266
AIR LIBAN, Place Riad Solh, Beirut, Lebanon.					
a) 4,915.2 t/mi 7,785.5 t/km b) 56.3	Henry Naccache, Managing Director J. P. Serrant, Business Manager	3 Douglas DC-6C 1 Douglas DC-4 3 Douglas DC-3	—	Points in Middle East, Africa & Europe	14,743 mi 23,727 km 501
AIR VIETNAM, 116, Bd. Nguyên-Huê, Saigon, Vietnam.					
a) 3,167.9 t/mi 5,098.3 t/km b) 93.8	Nguyên-Van-Khai, President Nguyên-Tân-Trung, Manager	1 Douglas DC-4 5 Douglas DC-3	—	Saigon to Hong Kong; points in South East Asia; domestic	11,800 mi 19,000 km 837
C.A.T., CIVIL AIR TRANSPORT, 46 Chung Shan Road, Taipei, Taiwan.					
a) 3,841 t/mi 6,182 t/km b) 84	Hugh L. Grundy, Managing Director Var M. Green, V.P. Traffic & Sales	1 Douglas DC-6B 2 Douglas DC-4 3 Curtiss C-46	1 Convair 880	To Bangkok, Hong Kong, Manila, Okinawa, Tokyo, Seoul	6,013 mi 9,677 km 548

* Information compiled by *Interavia*; accuracy not guaranteed ** Associate member n.a. = not available

1958 a) *Revenue t/km* (in 1,000s) b) *Passengers* (in 1,000s)	MANAGEMENT	AIR FLEET *Available*	AIR FLEET *On Order*	PRINCIPAL ROUTES	*Route Mileage* (unduplicated) *Employees*
*** EL AL ISRAEL AIRLINES LIMITED**, 76, Maza Street, P.O. Box 438, Tel Aviv, Israel.					
a) n.a. b) n.a.	Brig.Gen. E. Ben-Arzi, Managing Director Dr. A. Rywkind, Deputy Managing Director Y. Palgi, Deputy Managing Director	4 Bristol Britannia 4 Lockheed 049	—	Israel to Europe and USA; to South Africa	12,200 mi 19,600 km 1,200
GARUDA INDONESIAN AIRWAYS N.V., Djalan Nusantara 15, Djakarta, Indonesia.					
a) 17,375 t/mi 27,963 t/km b) 27.9	Dr. M. Soetoto, President Dr. R. Sugoto, Exec. V.P. Dr. C. A. Mochtar, Exec. V.P.	19 Convair 240/340/440 20 Douglas DC-3	3 Lockheed Electra	Domestic; to Manila, Singapore, Bangkok & North Borneo	16,570 mi 26,670 km 3,966
I.A.C., INDIAN AIRLINES CORPORATION, Thapar House, Janpath, New Delhi, India.					
a) n.a. b) n.a.	V. Shankar, Chairman Air Commodore P. C. Lal, General Manager Capt. J. M. Engineer, Chief Operations & Training Manager Biren Mukerji, Chief Traffic Manager	10 Vickers Viscount 12 Vickers Viking 5 Douglas DC-4 58 Douglas DC-3 7 D. H. Heron	4 Vickers Viscount	To points in Afghanistan, Pakistan, Nepal, Burma and Ceylon; domestic	14,881 mi 23,949 km 9,463
IRANAIR, IRANIAN AIRWAYS, Avenue Saadi, Teheran, Iran.					
a) 6,393 t/mi 10,288 t/km b) 109	Reza Afshar, Managing Director Sherwood Nichols, Technical Director Jack Bartlett, Director/Operations	3 Vickers Viscount 3 Douglas DC-4 13 Douglas DC-3	—	Domestic; to Afghanistan, Iraq, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria	13,500 mi 21,700 km n.a.
IRAQI AIRWAYS, New Railway Station Building, Baghdad West, Iraq.					
a) 2.871 t/mi 4,620.5 t/km b) 79	Muhamad Raouf, Chairman Col. Mohammed R. Hassan, General Manager Kamal Mohammed Nouri, Sales Manager	4 Vickers Viscount 3 Vickers Viking 1 D.H. Dove	—	Points in Near and Middle East; Vienna, London, Athens, Rome, New Delhi	10,915 mi 17,566 km 726
J.A.L., JAPAN AIR LINES, Tokyo Building, 2-chome, Marunouchi, Chiyodaku, Tokyo, Japan.					
a) 45,254 t/mi 72,829 t/km b) 471	Seijiro Yanagita, President Shizuma Matsuo, Vice-President	4 Douglas DC-7C 5 Douglas DC-6B 10 Douglas DC-4	4 Douglas DC-8	Domestic; trans-Pacific to Seattle and San Francisco via Honolulu; Hong Kong; Singapore; Bangkok	28,272 mi 45,499 km 2,300
M.A.L., MALAYAN AIRWAYS LTD., Airways House, Raffles Place, Singapore 1.					
a) 4,159.8 t/mi 6,694.6 t/km b) 142.5	J. A. Vick, Managing Director Capt. J. W. Solly, General Manager Capt. J. R. Brown, Operations Manager	2 Vickers Viscount 1 Douglas DC-4 10 Douglas DC-3 3 D.H. Beaver	—	Points in Malaya, Thailand, Indonesia, Sarawak & N. Borneo	7,590 mi 12,215 km 1,250
M.E.A., MIDDLE EAST AIRLINES CO. S.A., Maktabi Building, Abdul Aziz Street, Beirut, Lebanon.					
a) 11,958 t/mi 19,244 t/km b) 97.7	Sheikh Najib Alamuddin, Chairman Col. Cyril Essely, Commercial Director Ernest Terleske, Controller General	7 Vickers Viscount 4 Douglas DC-3	—	Middle East; India; Pakistan; 7 points in Europe	33,919 mi 54,587 km 1,000
MISRAIR, Almaza Airport, Heliopolis, Egypt.					
a) 6,772 t/mi 10,899 t/km b) 133	Hassan Mahmoud, Managing Director M. S. Milisi, General Manager	6 Vickers Viscount 6 Vickers Viking 4 Douglas DC-3	—	To points in Europe, Africa and Middle East	10,326 mi 16,619 km 1,685
P.A.L., PHILIPPINE AIR LINES, M.R.S. Building, Plaza Cervantes, Manila, Philippines.					
a) 10,635 t/mi 17,115.5 t/km b) 502.6	Col. Andres Soriano, President Andres Soriano, Jr., 1st V.P. Renato Barretto, V.P. Ops.	2 Vickers Viscount 1 Convair 340 27 Douglas DC-3 9 others	2 Douglas DC-8 2 Fokker F.27	Domestic to 70 points in Philippines; regional to Hong Kong	9,825 mi 15,812 km 2,063
P.I.A., PAKISTAN INTERNATIONAL AIRLINES CORP., Central Hotel Building, Khuro Rd., Karachi, Pakistan.					
a) 16,414 t/mi 26,414.5 t/km b) 206.9	Mirza Ahmad Ispahani, Chairman A/C M. Nur Khan, Managing Director G/C M. A. Dogar, Operations Director	3 Vickers Viscount 5 Lockheed 1049 C/H 3 Convair 240 10 Douglas DC-3	2 Vickers Viscount	Karachi–Teheran–Baghdad–Damascus–Rome–Geneva–London; points in India, Burma & Afghanistan; domestic	13,443 mi 21,634 km 3,611
SUDAN AIRWAYS, P.O.B. 253, Khartoum, Sudan.					
a) 1,761.7 t/mi 2,835.4 t/km b) 30.8	Abdel Bagi Mohamed, General Manager Yousif Bakheit Arabi, Traffic Manager	1 Vickers Viscount 7 Douglas DC-3 4 D.H. Dove	—	Domestic; to Middle East; to Athens–Rome–London	6,576 mi 10,583 km 456

AUSTRALASIA

**** ANSETT-A.N.A.**, 289, William Street, Melbourne, C.1., Victoria, Australia.					
a) 48,980 t/mi 78,826 t/km b) 780	R. M. Ansett, Chairman J. A. West Lau, General Manager G. S. Drury, Assistant to General Manager Capt. P. J. Gibbes, Operations Manager	2 Lockheed Electra 6 Vickers Viscount 3 Convair 440 6 Douglas DC-6/6B 13 Douglas DC-3 2 Douglas DC-4 3 Bristol Freighter 4 helicopters	—	Connections between State capitals	16,332 mi 26,284 km 3,750
**** N.Z.N.A.C., NEW ZEALAND NATIONAL AIRWAYS CORP.**, Aotea Quay, P.O. Box 96, Wellington, New Zealand.					
a) 90,688.6 t/mi 145,949 t/km b) 553.3	Air Vice-Marshal Sir Leonard Isitt, Chairman J. J. Busch, General Manager	3 Vickers Viscount 2 D.H. Dominie 26 Douglas DC-3	—	New Zealand domestic	3,459 mi 5,567 km 1,738
QANTAS EMPIRE AIRWAYS LIMITED, Qantas House, 70, Hunter Street, Sydney, Australia.					
a) 66,504 t/mi 107,031 t/km b) 176	Sir Hudson Fysh, Chairman W. C. Taylor, Vice-Chairman C. O. Turner, Chief Executive and General Manager Capt. G. U. Allan, Deputy Chief Executive and Deputy General Manager	5 Boeing 707 16 Lockheed 1049 4 Douglas DC-4 8 Douglas DC-3 4 D.H. Otter	2 Boeing 707 4 Lockheed Electra	Services to Europe and U.K. via India and North America; San Francisco; Vancouver; New Zealand; Hong Kong; Japan; points in South Pacific	76,877 mi 123,721 km 6,049
**** T.A.A., TRANS-AUSTRALIA AIRLINES**, 339, Swanston Street, Melbourne, C.1., Australia.					
a) 32,127.9 t/mi 51,704.7 t/km b) 851.4	John P. Ryland, General Manager J. Chapman, Assistant General Manager L. L. McKenzie, Commercial Director R. E. Bailey, Director of Operations	2 Lockheed Electra 15 Vickers Viscount 8 Fokker F.27 2 Convair 240 18 Douglas DC-3	4 Fokker F.27	Australian domestic	29,457 mi 47,406 km 3,993
*** T.E.A.L., TASMAN EMPIRE AIRWAYS LIMITED**, P.O. Box 2201, Mechanics Bay, Auckland, New Zealand.					
a) n.a. b) n.a.	F. A. Reeves, General Manager J. W. Veale, Assistant General Manager	3 Douglas DC-6 1 Short Solent	—	Between Australia and New Zealand; to Pacific island points	10,022 mi 16,129 km 820

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The AW Argosy carries up to 83 passengers or 13½ short tons of freight, or any combination within this payload. A typical mixed load would be over 7 tons of freight and 35 passengers. Rolls-Royce Dart turbo-prop power ensures a low noise level for the passengers seated in pressurised comfort. Large fore-and-aft freight loading doors reduce turnround to 20 minutes. Components and systems are all well-tried and chosen for easy maintenance. Both passengers and freight can be loaded simultaneously.

PERFORMANCE *Power: 4 Rolls-Royce Darts.*
Aircraft cruising speed: (14,000 r.p.m.) 296 m.p.h. (475 km./hr.).
Maximum payload: 27,000 lb. (12,247 kg.).
Range with fuel reserves and 20,000 lb. (9,072 kg.) payload: 1,000 st.m. (1,610 kil.).
Size of hold: 46 ft. 8 in. (14.23 m.) x 10 ft. (3.05 m.); floor area 426 sq. ft. (39.6 sq.m.).

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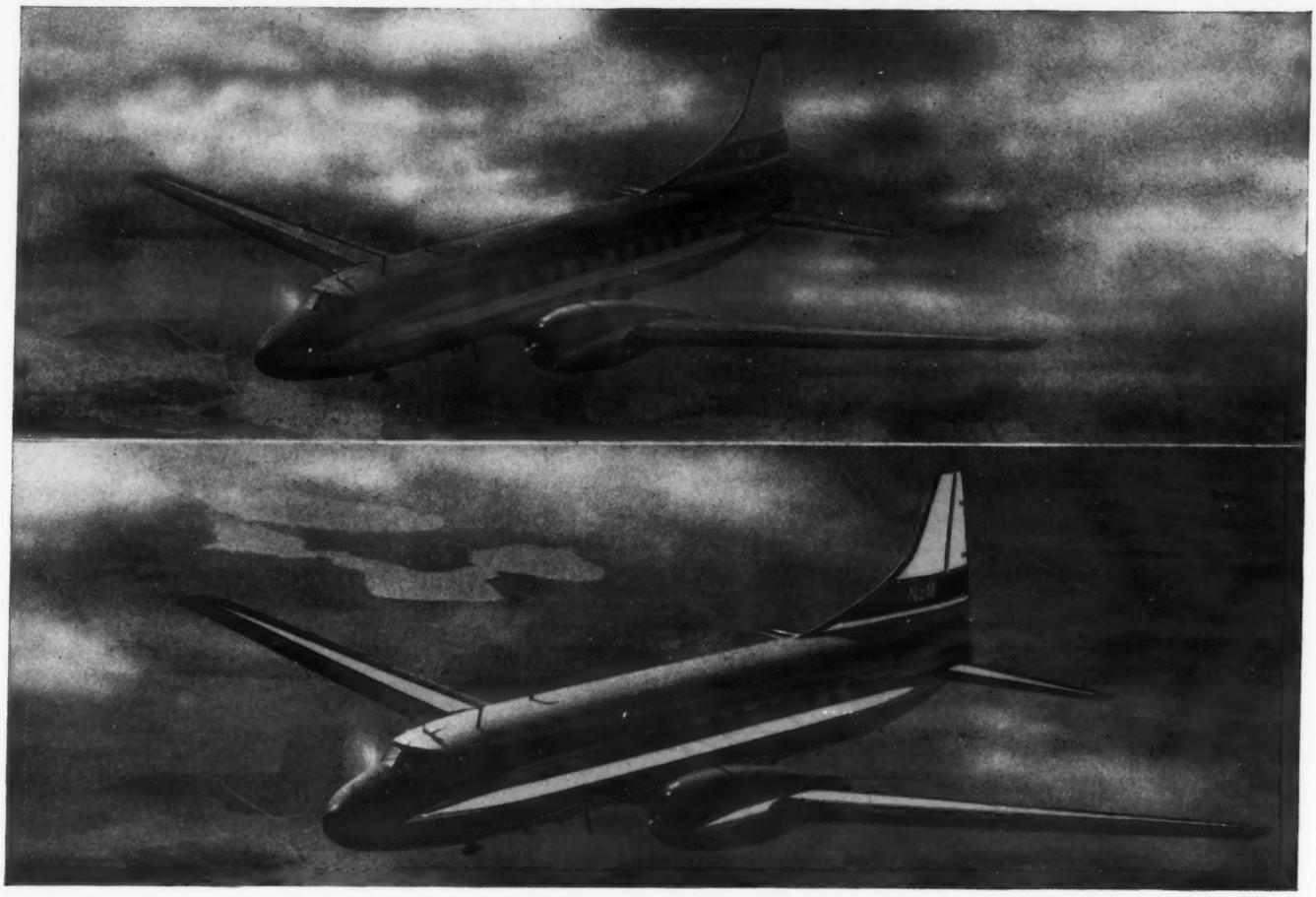

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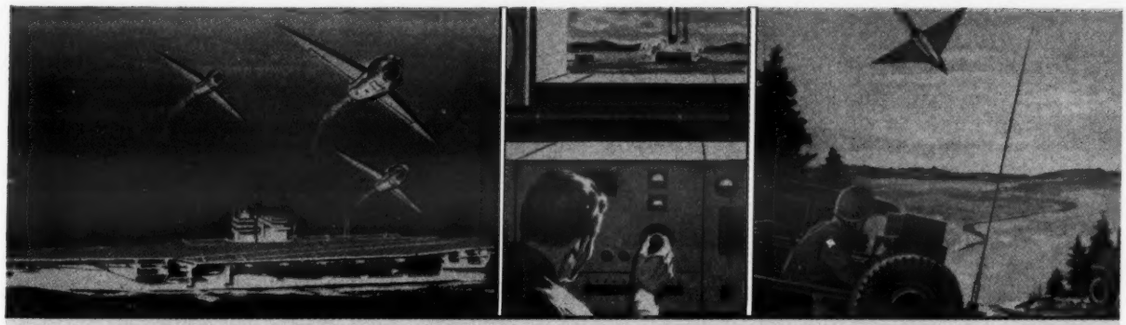

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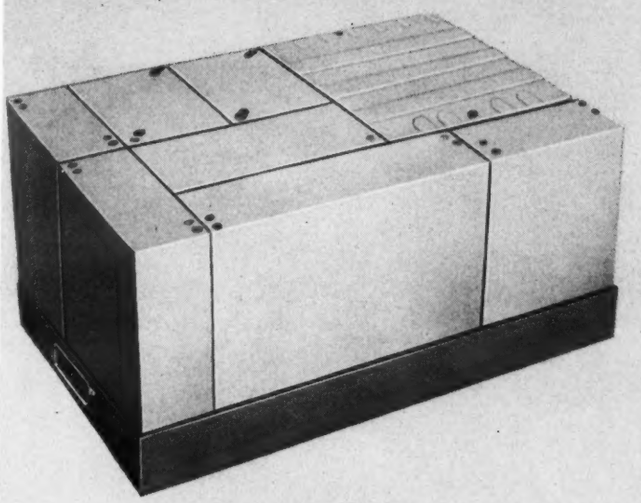

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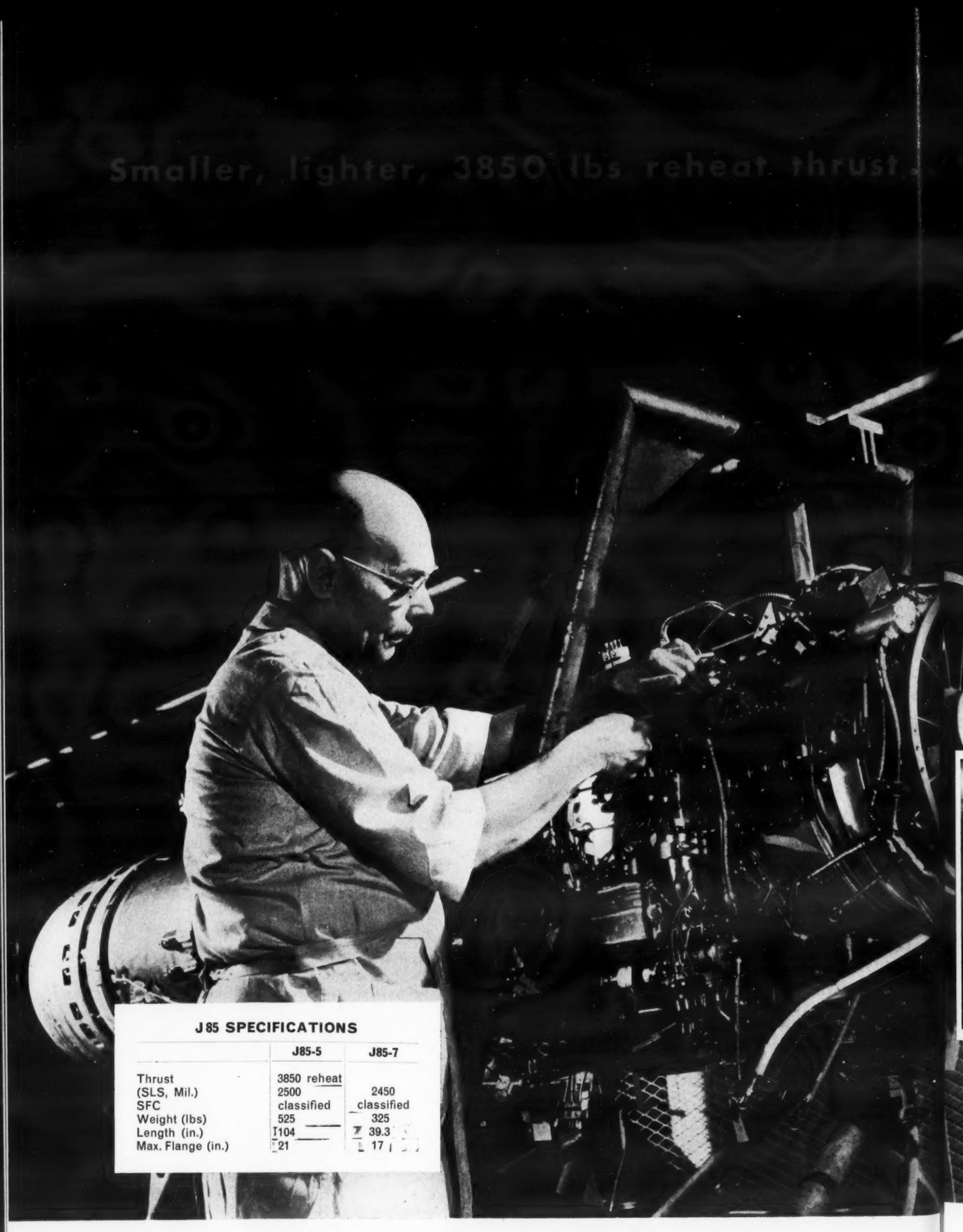

J85 SPECIFICATIONS

	J85-5	J85-7
Thrust (SLS, Mil.)	3850 reheat 2500	2450
SFC	classified	classified
Weight (lbs)	525	325
Length (in.)	104	39.3
Max. Flange (in.)	21	17

General Electric J85 engines are now in production at the Company's Small Aircraft Engine Dept., Lynn, Mass.

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General Electric J85 turbojet helps reduce airframe size, weight, cost... boosts mission performance

SMALLER AND LIGHTER than comparable turbojets, General Electric's new J85 reduces airframe size, makes possible significant savings in airframe weight . . . corresponding reductions in airframe costs.

RATED AT 3850 LBS REHEAT THRUST, and 2500 lbs dry thrust, the J85-5 weighs only 525 lbs. Its missile counterpart, the J85-7, delivers 2450 lbs thrust . . . weighs only 325 lbs.

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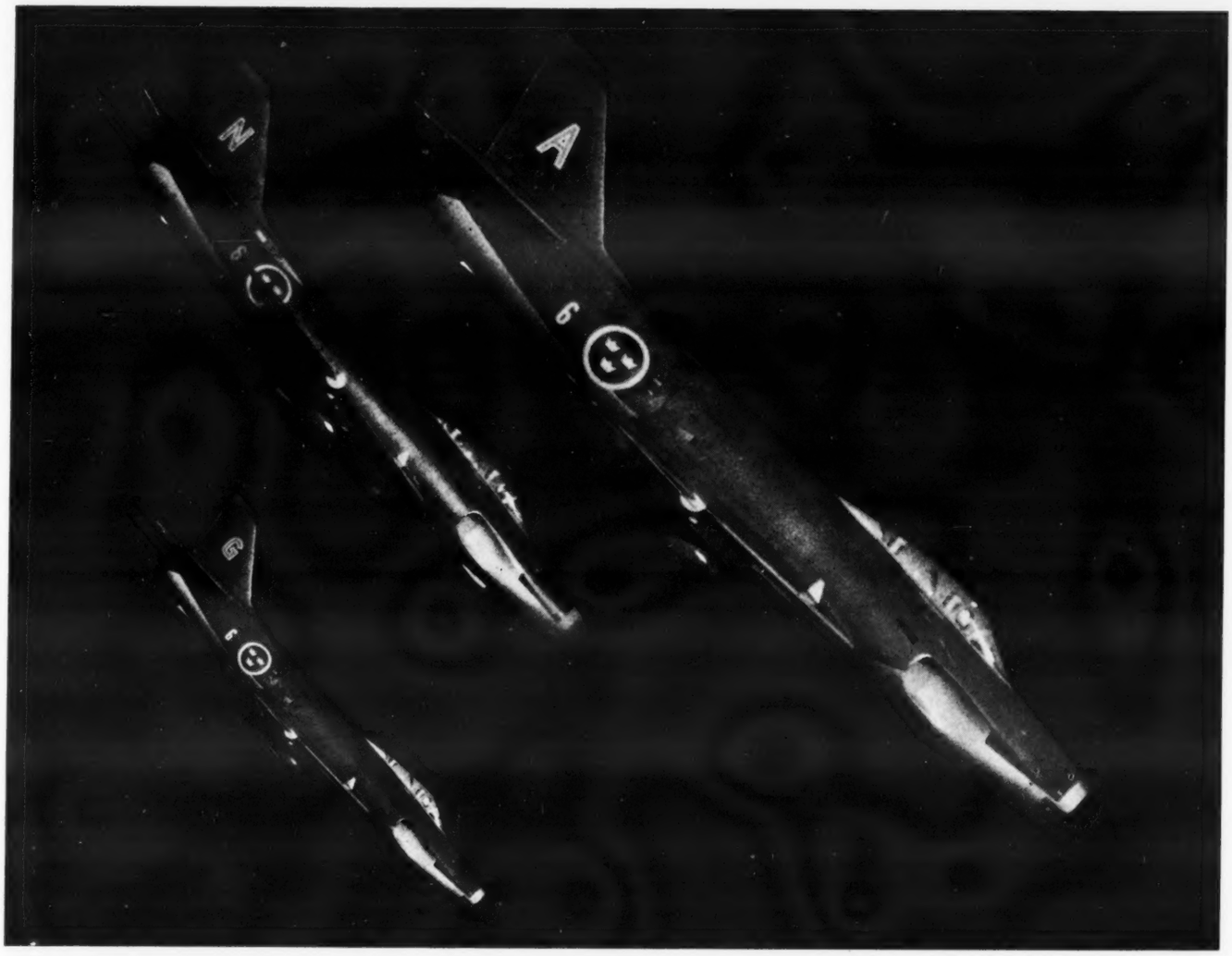

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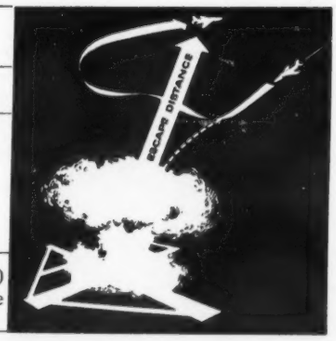
Saab BT9 Toss Bomb Computer Range of applications	
Altitude	0—6,000 m (0—20,000 ft)
Speed	M=0.5—1.0
Dive angle	10°—50°
Acceleration in pull-out	3—7 g
Maximum slope distance	1,000—15,000m.(3,300—50,000ft.) (depending on speed, dive angle and bomb characteristics



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How can the airlines — in particular the European airlines — make air travel accessible to the broadest sections of the population, without endangering their economic stability ?

by Raymond Nivet, Paris

The adjudicators for the civil subject in the Interavia Essay Competition awarded the second prize to a 37-year-old French subject who has already had an eventful and distinguished career in aviation. Armed with an Honours Degree in Mechanical Engineering, Raymond Nivet reached the United States via Spain and North Africa in 1943 and subsequently stayed in the USA as a pilot instructor with the French Air Force until his return to Europe in 1946.

Mr. Nivet has now served Air France for more than eleven years, first as engineer and latterly as Chief Engineer, and the arguments expressed in his essay are therefore those of a professional in close touch with the everyday problems facing a major airline.

Editors.

The number of travellers must be increased

According to estimates made by the ICAO Secretariat in a recent publication, the available capacity of world air carriers seems appreciably in excess of predicted traffic requirements. This surplus capacity is expected to reach over three million tonne-kilometres in 1960, i.e. about 25 per cent of the total capacity offered.

The ICAO Secretariat's hypotheses are, of course, disputable, for they have been established on the assumption that piston-engined aircraft fleets will still be operating in 1961, that the average load factor will remain constant, and that traffic requirements will increase at an average annual rate of 15 per cent. If, however, it is assumed that 20 per cent of existing piston-engined aircraft will be withdrawn from service by 1961, the excess capacity will disappear.

There are considerable differences between the traffic forecasts published by various sources: in 1957 Boeing predicted that passenger traffic would be doubled in four years, Convair, in seven. The total increases corresponding to these forecasts by 1961 are 96 per cent and 58 per cent respectively. This being so, it is necessary to be very cautious in evaluating certain results.

It may nonetheless be difficult for companies to make full use of their capacity and run their aircraft economically without reducing the utilization envisaged for new models. All operators are thus faced with the burning problem of increasing the demand for air transport.

Has future traffic been accurately forecast ?

All calculations of transport requirements for the next four or five years are based purely on the results recorded in recent years, even when taking account of factors such as average national revenue, proportion of wage-earners to the population as a whole, increases in population etc. Some people may feel that it is somewhat optimistic to assume that the rate of increase observed between, say, 1947, and 1957 will also apply to the future, even if no serious economic upheavals occur. In my opinion this way of thinking neglects two important points: firstly, air transport, in spite of its high degree of technical perfection, is still almost in its infancy in the sense that it is outside the experience of the majority; secondly, market research has been too limited and lacking in that imagination which operators will have to use if they are to keep their aircraft full and their balance-sheets out of the red in the jet age.

I was recently struck by some official statistics on the means of transport used by French holidaymakers. Listed in order of importance were train, bus, car, and finally " scooter, motorcycle and others." Thus, despite the continual expansion of which the operators boast, despite the revolutionary changes which it has brought about in international relations, air transport can still, on the threshold of the jet age, be classified in statistics under the heading " miscellaneous " !

Of course, this is a special case, for the French tourist travels predominantly inside France, where distances are short, railway connections are convenient, the road network is extensive and, above all, it is inexpensive to stay with relatives. Even in the United States, however, where all the factors favouring air transport are simultaneously present, where living standards are high, transport is cheap and the population mobile, the proportion of adults making at least one air trip a year does not exceed 7 per cent, and the proportion of adults who have never travelled by air is still 75 per cent !

These figures are encouraging, for they show that the potential market for air travel is still very wide.

Why do people travel, or not travel, by air ?

At this point two questions arise: Why do airline passengers travel by air ? Why do other travellers, or those who do not travel at all, not use air transport ?

Some airline passengers travel on business: their proportion (in relation to total passenger volume) varies in direct ratio to the economic difficulties of their country: one American in five, one Frenchman in three, one German in two. Let us deal straight away with this category of passengers, who fill the first class seats, and for whom the fare level is not of primary importance. I do not speak here of group transport of labour by charter companies, where numbers are slowly increasing with all-round economic expansion. The tightening of economic links between the " Six " or " Seventeen " will no doubt bring about a moderate, though not spectacular increase in exchanges of labour.

Business traffic increases with speed. It has been shown that half of all business travellers do not travel more than twelve hours away from their starting-point, while only a sixth fly more than twenty-four hours away from home. Now, with the replacement of conventional four-engined aircraft by four-jet aircraft, the area of a circle with a " twelve-hour radius " is quadrupled; centred on Western Europe, it covers most of the inhabited world.

The market for business travel being what it is, it is left to the tourist to become the air carriers' " goose that lays the golden eggs ". For the man in the street to become travel-minded, and, what is more, air travel-minded. he must have the inclination, the time and the means. Air transport companies can influence all three of these factors.

Advertising must be adapted to reach the mass market

Sir William Hildred, Director General of IATA, recently stressed the importance of advertising in the conquest of the mass market. It will be necessary to sound the reactions of a still inexperienced sector of customers who will need both advising and reassuring. This presupposes a change in the sales promotion methods at present used by most companies. Studies of the market are too limited and are directed against competitors; advertising campaigns are conducted for the benefit of those who already fly, in a spirit which is all too often merely one of rivalry designed to capture, at the expense of competitors, a larger share in the more or less stable " business " market. Characteristics of this policy are slogans such as " X Airways, the only company to offer a direct service ", " Y Airlines, the only company to offer a daily service ", slogans which will not sell the general public the idea of " holidays by air ".

Speed and ease of travelling as sales points

It has been said that speed, being the essential factor in air transport, is the product which must be sold. It should be presented in the most attractive form, namely that of time gained, time which the traveller can devote to business, pleasure, or holidays, rather than waste it on long journeys, or give up the idea of seeing the world and its wonders for lack of time.

The general public mistrusts long journeys; is it not significant that the average length of air trip per passenger is always in the region of three

hours ? To compensate for longer travelling time it is necessary to sell ease of travel. The ever-growing number of routes makes travelling simpler, but that is not enough. Many passengers are still apprehensive of the long hours spent waiting at airports and the archaic formalities with which officious authorities bedevil air transport; in many cases and on certain routes this applies to air transport alone.

The most effective way of reaching the masses who have not yet become used to the idea of air transport is to offer organized tours. These in some degree alleviate the difficulties caused by language barriers, spare the traveller the necessity of writing to hotels and coping with formalities of all kinds, and above all enable him to " budget " his holiday.

Tariff reductions are essential

Now we get down to the crux of the matter: tariffs. Potential traffic has often been compared to a pyramid whose height depends on the level of fares; as fares are lowered, so the base of the pyramid moves further away from the apex, the increase in volume representing a corresponding growth in traffic.

If air transport is to expand, fares will therefore have to be considerably lowered. The magnitude of the problem is underlined by the statistics on American passengers flying the North Atlantic; the highest percentage of passengers are those spending five to eight weeks abroad; the market for those with only two to three weeks' holiday to spend has not even been touched. When it is considered that in the United States more than half those who have made one air trip a year have an annual family income of more than 10,000 dollars, while the income group earning less than 4,000 dollars a year accounts for only 2 per cent of air traffic, we can see in its full extent the problem of sales promotion to attract the enormous number of wage-earners with incomes ranging from 4,000 to 8,000 dollars.

Tariff reductions can take the form of promotional tariffs, such as off-season fares and reduced fares on off-peak days; measures such as these will also help to spread the traffic load and ensure better aircraft utilization. Certain adjustments to existing fare levels are also required; a new low-price service should be created. The growth in traffic as a result of the introduction of tourist services in 1952 and, more recently, of " economy " services on the North Atlantic, abundantly demonstrates the influence of the tariff factor: North Atlantic traffic recorded in July and August, 1958, was 40 per cent above traffic for the corresponding period in the previous year, the number of " economy class " passengers representing about 70 per cent of the total.

The introduction of deferred payment will widen a market if accompanied by a reduction in fares, and this method may be applied with particular effect in the case of inclusive tours.

Factors which favour the development of traffic

Certain factors are favourable to sales promotion campaigns by air carriers. The world's working population is on the increase; in the next three years the working population of the United States will rise from about 70 to over 80 million. Air traffic normally increases at a higher rate than population as a result of the general improvement in living standards. Though not reaching the annual rate of increase of 18 per cent recorded in the USA, the gross national product of the countries of Europe is rising steadily.

New countries are being opened up to industrial progress and tourist travel, which should in the long run bring about a considerable improvement in the standard of living of their inhabitants, making them potential customers for air transport.

Finally, there is one point, often neglected, but which is nevertheless important: the air-mindedness to be noted in rising generations, coupled with the need for all kinds of international exchanges which has sprung up since the end of the Second World War.

Numerous obstacles to air transport

Recent years have seen an unprecedented development in motor transport. At the outset of the last summer holiday period, it was estimated that 82 per cent of Americans were preparing to set out by car, as against 6 per cent who were travelling by rail and 5 per cent who were flying. It should be noted, however, that 26 per cent of those travelling further than 2,000 miles were going by air, as against one per cent for those travelling less than 500 miles.

The car has, it must be admitted, many advantages. It is an individual means of transport and thus enables the driver to go where he pleases without observing timetables of any kind; the luggage problem is often simplified; and the adventurous or badly organized tourist does not suffer from a shortage of hotel rooms *en route*. Lastly, and most important, the car is the most economical means of transporting a family.

It would seem difficult to beat the motor-car on its own ground; but the public must be dissuaded from using it over distances for which it was not designed; intercontinental transport must be promoted and car hire at destination encouraged.

Shipping companies were on the right track in concentrating on car ferry services to counteract traffic losses: 182,000 British tourists and 41,000 French tourists crossed the Channel with their cars in 1957.

Uncertainties in tourist traffic

Objections to a low-fare policy which will open the air market to a larger number of tourists are based on the fact that transport and sales of luxury goods are the first to suffer in an economic recession. This argument has its validity; we all remember the spectacular drop in trans-Atlantic traffic as a result of the American crisis in 1929. To stop at such considerations would, however, amount to an abandonment of all creative initiative in this direction; moreover, despite the recent economic recession, the year 1958 saw an unprecedented boom in trans-Atlantic air traffic.

A more valid objection is that of poor fleet utilization as a result of the heavy tourist load at peak traffic periods. Already more than 40 per cent of Americans visiting Europe do so during the third quarter of the year; any significant expansion in the holiday market will risk increasing this overload. Promotion of air travel should aim at encouraging travel at off-peak seasons of the year. There are many ways of doing this, such as off-season fares and the promotion of flights to new regions where the climate is favourable. Perhaps not enough has yet been done to " sell " the charm of sunny beaches in winter to dwellers in the mists, rain and smoke of the great industrial cities of the European continent. The example of Florida is interesting: from a winter playground for the rich it has become the resort of a wide sector of the population throughout almost the whole year, without, however, the December-January peak being absorbed. Some companies have noticed this phenomenon and found a solution, exchanging their four-jet aircraft to deal with peak traffic periods which, fortunately, are staggered throughout the year.

The special position of European air transport

The European air traffic situation is particularly difficult. With an air space comparable to that of the United States and almost double the population, Europe accounts for barely a quarter of world air traffic. What is more, European carriers' own traffic largely serves points outside Europe; with the exception of one company which exists to serve Europe, their networks seem to be planned almost entirely as feeders for the long-haul routes.

The reasons for this relative deficiency in European air traffic are well known: political frontiers fortified by economic barriers; the stay-at-home character and low income level of the population; and the structure of the European network, which consists of a series of national networks radiating outwards from the capitals. Finally, operating costs raise intra-European air tariffs to a discouragingly high level.

In Europe more than elsewhere, however, it is essential to look for new markets in order that the European carriers can fully utilize the large numbers of jet airliners which they have ordered in the knowledge that the operator who does not enter the re-equipment race is condemned to disappear from world competition.

Two ways appear to lie open to European air transport. Firstly, it should be possible to increase the flow of American tourists to Europe, which already accounts for the major share of trans-Atlantic traffic and is of considerable importance in intra-European traffic. The rise in the average family income in the United States, the increasing population, and an intensive advertising campaign should make it possible to divert to Europe part of the heavy traffic which now plies between the states of north-eastern America and the sunny region of Florida and the Caribbean, or between the western states and Hawaii. A weekly average of 26,000 seats is offered throughout the year between the north-eastern states and Florida, 15,000 between the United States and the Caribbean and over 5,000 between the American continent and Hawaii. These figures should be compared with the weekly average of some 13,000 seats offered across the North Atlantic. American tourist traffic is of particular interest to Europe, since it not only helps to fill long-haul or intra-European airline capacity, but brings with it an influx of much-needed currency to improve the economies of the many European States for which the foreign tourist trade is becoming more and more of an export industry.

A study of the European network structure reveals the surprising fact that Europe offers nothing comparable to Florida and the Caribbean, which are the poles of attraction for so many tourists in the New World. As a European air-transport personality recently remarked, European " Miamis " should be found in the Mediterranean basin, whose climate has an undoubted appeal for the inhabitants of continental Europe. A tourist movement of this kind could be spread over most of the year, thus enabling traffic to be regulated. It is, perhaps, not too much to hope that it will be possible to embark on a more realistic European tourist policy once the Common Market has become a reality and the various projects for cutting down the restrictions to freedom of movement in Europe have been put into effect.

The development of European tourist travel is in the hands of governments

Unfortunately, the development of European tourist travel is subject to factors other than air transport, which control its potentialities. As Sir William Hildred remarked, air transport has many associates; the operators of other means

of transport, hotels, resorts, travel agencies, and above all governments, for whom travel represents a part of the nation's economy. The success or failure of one of the associates helps or hinders the trade of the others.

One can detect in Europe a certain anomaly between the dynamism of transport and the static condition of the hotel industry. If this situation persists or deteriorates as the flood of tourists attracted by cheap travel grows, then we shall risk seeing the tourist stream diverted from Europe to regions which are better equipped, cheaper or not yet saturated.

Finally, an effort should be made to create resorts and build hotels: we can imagine the effect of a movement of tourists to, say, Corsica, where the annual growth of the trade is already nearly 10 per cent, if tourist facilities were improved. At the present time nearly all of its 500 miles of coastline are entirely without hotel accommodation, and many of the finest beaches are inaccessible.

Companies should draw the attention of governments and the organizations concerned to this important problem and convince them of the fact that the tourist spends more in the country he visits than he does for the ticket which takes him there.

The problems involved in reducing fares

Of all the problems to be faced, one is of particular importance, and its solution depends on the companies themselves. Profit margins are already too low, and on most operations barely exceed one per cent of total resources. Profits are squeezed between steadily rising operating costs and a limited tariff level which operators are asked to reduce still further.

What is more, the need for capital is greater and is becoming increasingly difficult to satisfy owing to the uncertainty of returns, which discourages investment in air transport.

Various solutions have been proposed, of which some are negative and directed against the technical and economic progress represented by the new generation of aircraft. The latter offer not only a speed and comfort hitherto unknown, but also the possibility of lower costs per tonne-kilometre if the load factor remains at a reasonable level and the aircraft are properly utilized.

It has been proposed that operators should agree to slacken the rate of aircraft re-equipment and thereby reduce capital requirements and overheads. This would be to go against the law of re-equipment recalled by C. R. Smith, which lays down that any machine must be replaced by another which can perform the same service more efficiently. We may regret the absence of an aircraft with a high lift/drag ratio and a reasonable speed, which can transport passengers over short distances at half today's fares; but does not mass transport by aircraft with a high traffic potential over distances where competition from the private car and other surface transport is not to be feared, present a more attractive prospect than the development of short-haul markets ?

To help carriers who cannot replace their fleets of conventional aircraft by jet airliners, the establishment of a system of differential rates has been proposed. But if the economy of operating jet aircraft is what we have been led to expect, a lowering of the tariffs for conventional four-engined aircraft in the necessary proportion — for there would be no point in a purely symbolic difference—would cause losses. To compensate such losses by increasing the tariffs for four-jet aircraft would amount to an arbitrary infringement of the principles of sound economic management. To set one's face against progress is a mistake which is costly, as experience in other fields has already shown.

It is true that certain companies will find themselves in an extremely difficult position, and may even be forced to give up operations. But were not the railways also forced to close down certain branch lines ?

Operating costs must be reduced, particularly in Europe

The need for substantial tariff reductions leads to a consideration of the urgent problem of cutting operating costs, linked with that of aircraft utilization. Here again European air transport is seriously handicapped. In spite of the fact that personnel salaries, with the possible exception of flight crews, are half those paid in the United States, operating costs per tonne-kilometre are double. This is due to the network structure, which makes it impossible to arrange satisfactory timetables compatible with the best utilization of the aircraft (4 hours 20 minutes flight per aircraft per day as against 7 hours in the USA), and to the low productivity per line, per halt, and hence per employee.

An overall increase in European air traffic would obviously cut the proportion of overheads, and the solutions which are valid on a world-wide scale can be applied in spite of certain difficulties connected with government policies and other activities linked with the tourist industry. There must be an intense advertising campaign to develop new markets and get the masses used to the idea of holidays by air; the campaign should be supported by a lowering of tariffs, the introduction of promotional tariffs, an inclusive tour policy, travel on credit etc. Companies will also have to work together to economize on operations by measures such as pooling of spare parts, mutual assistance at halts, specialized maintenance of certain aircraft types by one company, etc. The agreement between SAS and Swissair has shown that it is still possible to show imagination in this field.

European carriers must cooperate

Cooperation between carriers could be extended beyond mere technical assistance. Many studies have been made with this in view, both by the carriers themselves and by organizations such as the Air Research Bureau or the European Civil Aviation Conference. Inevitably, all the solutions proposed have their drawbacks or are beset by difficulties which will remain as long as European states maintain their present attitude to transport. What is more, many companies which have been prevented by circumstances from attaining the state of development appropriate to their country's traditional economic position, would be loath to have their share in overall European air transport activity arbitrarily fixed for all time.

It has recently been said that the solution to the European air transport problem seems to lie less in a rigid system constituted in advance by law than in acquiring a habit of cooperation which would enable European companies to undertake a common study of their problems and find realistic solutions. Such cooperation would encourage European tourist travel, lead to better aircraft utilization through the introduction of more rational timetables and reduce operating costs by a pooling of resources. All these measures, accompanied by an investigation of complementary activities with a view to improving aircraft utilization (air freight, charters etc.) will create the conditions for the indispensable tariff reductions.

The air transport industry is young, but growing rapidly. If European companies wish to reduce operating costs and win a larger share of international tourist traffic from their competitors across the Atlantic, they must make haste to coordinate their efforts, for they have not a moment to lose.

Turbine-

Though the question of airline fleets for the coming decade has still not been exhaustively answered, a clearer picture is beginning to emerge with the massive aircraft orders which the airlines have placed during the past few years. The time would therefore appear to have come round again to present a survey of available modern aircraft. The following tables are based on the latest obtainable information. However, since manufacturers frequently incorporate modifications in the course of development of an aircraft, to meet customers' individual wishes, discrepancies in the data for different series of the same type are unavoidable. Sub-division of the aircraft into turboprops (Tables I and II) and jets (Tables III and IV) reflects development trends in the two main rival categories and shows that both basic categories will continue to operate side by side for a good many years to come. Not until the introduction of supersonic aircraft—in perhaps another ten years—will the pure jet outrun the propeller turbines, at any rate in long-range fleets. Design considerations behind one of the projected supersonic airliners are described in the following article.

During the sixties, however, the subsonic types shown in the present survey can be expected to dominate the field, perhaps joined—at the lower end of the scale—by new types of STOL aircraft for use on the shorter stages. Even today, the range of aircraft sizes required by the world's airlines is astonishingly wide, as is clearly revealed by the accompanying silhouettes (scale 1: 1,000). Perhaps, despite the growing speed span, development will ultimately lead to a smaller number of multi-purpose types, which would make it possible to rationalize the air transport business on a world-wide scale. For the time being, however, manufacturers are proud to be able to offer their customers the biggest possible range of aircraft. The main details of 42 of these types, some of which are already in service, are given in the following tables.

Powered Airliners of Today and Tomorrow

Medium and Long-Range Turboprop Transports

Aircraft Type	Bristol Britannia 320[1]	Vickers Vanguard Type 950 Mk.II	Ilyushin IL-18 Moskva	Tupolev Tu-114 Rossiya	Canadair[3] CL-44D	Lockheed Electra
COUNTRY	GREAT BRITAIN		SOVIET UNION		CANADA	USA
Engines (number and type)	4×Bristol Proteus 765	4×Rolls-Royce Tyne R.Ty.11	4×Kuznetsov NK-4	4×Kuznetsov NK-12N	4×Rolls-Royce Tyne R.Ty.12	4×Allison 501-D13
Max. sea level take-off rating	4×4,450 e.h.p.	4×5,525 e.h.p.	4×4,000 e.h.p.	4×12,000 e.h.p.	4×5,730 e.h.p.	4×3,750 e.h.p.
Wing span	142′ 3,5″	118′ 8″	122′ 8″	~ 177′	142′ 3,5″	99′
Length	124′ 3″	122′ 10″	118′ 1″	165 +′	136′ 7,27″	104′ 6,5″
Wing area	2,075 sq.ft.	1,529 sq.ft.	1,318 sq.ft.	—	2,075 sq.ft.	1,300 sq.ft.
Grossweight	185,000 lb.	141,000 lb.	127,900 lb.	396,800 lb.	205,000 lb.	116,000 lb.
Max. payload (capacity limited)	34,369 lb.	29,000 lb.	30,865 lb.	~ 55,100 lb.	37,630 lb. (pass. vers.) 63,272 lb. (freight vers.)	26,540 lb.
Max. fuel capacity (volume)	8,580 Imp gals	5,100 Imp gals	—	~ 16,500 Imp gals	12,190 U.S. gals	5,520—6,420 U.S. gals
Max. landing weight	137,000 lb.	121,000 lb.	—	275,600 lb.	165,000 lb.	95,650 lb.
Passenger capacity (tourist class)	max. 149	120/139 (Tourist/Economy)	100	170/220	172/189	66/99
Passenger capacity (first class)	—	97	75	120	—	—
Total hold capacity	900 cu.ft.	1,360 cu.ft.	1,190 cu.ft.	—	1,011 cu.ft.	636 cu.ft.
Max. cruising speed	355 kn	370 kn	350 kn	380/430 kn	350+ kn	—
Recommended cruising speed	345 kn	364 kn[2]	—	—	~ 320+ kn	351 kn
(at indicated cruising altitude)	22,000′ at 150,000 lb.	—		—	~ 20,000′	22,000′
Average cruising altitude	20,000—30,000′	20,000′	26,250′	32,800—36,000′	20,000—30,000+′	22,000′
CAR runway length at max. take-off weight—sea level (ICAN)	8,150′	6,000′	2,460′ Take-off run	~ 9,190′	7,660′ Take-off distance to 35′	4,150′
CAR landing run at max. landing weight—sea level (ICAN)	6,000′	5,850′	1,970′ Landing run	~ 5,900—6,560′	6,780′ Landing distance from 50′	4,270′
Typical still air range	4,640 n.m.	1,700 n.m.	~ 1,000 n.m.	~ 2,700 n.m.	2,500 n.m. freight vers.	2,360 n.m.
(for indicated payload)	(23,000 lb.)	(29,000 lb.)	(30,865 lb.)	(~ 40,000 lb.)	3,500 n.m. pass. vers. (with max. payload)	(20,000 lb.)
		max. 2,460 n.m. (with normal reserves)	~ 2,700 n.m. (17,640 lb.)	~ 4,300 n.m. (?)	(2 hr stacking at 15,000′) 4,910 n.m. (max. fuel)	For 2 hr. fuel reserves

Medium and Short-Range Turboprop Transports

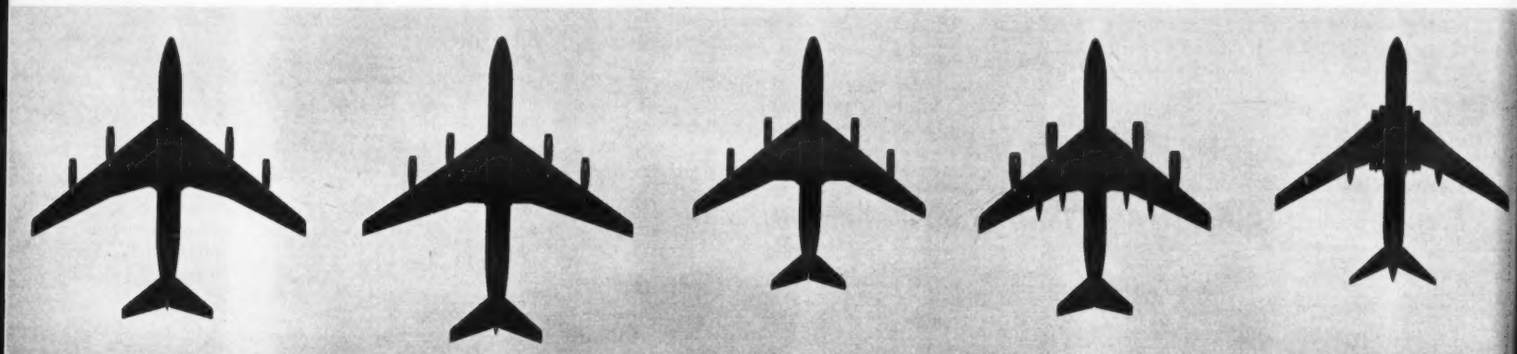
Aircraft type	Armstrong Witworth AW.650 Argosy[4]	Avro 748	Handley Page Dart-Herald	Vickers Viscount 700D	Vickers Viscount 810	Fokker F.27 Friendship[8]	Antonov An-10 Ukraina	Canadair-Convair 540
COUNTRY	GREAT BRITAIN					NETHERLANDS	SOVIET UNION	CANADA
Engines (number and type)	4×Rolls-Royce Dart R.Da.7/2 Mk.526	2×Rolls-Royce Dart R.Da.6 Mk.514	2×Rolls-Royce Dart R.Da.7/2 Mk.527	4×Rolls-Royce Dart R.Da.6 Mk.510	4×Rolls-Royce Dart R.Da.7/1 Mk.525	2×Rolls-Royce Dart R.Da.6 Mk. 511 or R. Da. 7 Mk. 528	4×Kuznetsov NK-4 or AI.20	2×Napier Eland 6
Max. sea level take-off rating	4×2,100 e.h.p.	2×1,740 e.h.p.	2×2,100 e.h.p.	4×1,740 e.h.p.	4×1,990 e.h.p.	2×1,740 e.h.p. or 2×2,105 e.h.p.	4×4,000 e.h.p.	2×3,500 e.h.p.
Wing span	115′	95′ 0″	94′ 9″	93′ 8″	93′ 8″	95′ 2″	141′	105′ 4″
Length	86′ 9″	67′ 0″	72′ 0″	81′ 10″	85′ 7″	75′ 9″	119′	81′ 6″
Wing area	1 458 sq.ft.	795 sq.ft.	886 sq.ft.	963 sq.ft.	963 sq.ft.	754 sq.ft.	—	920 sq.ft.
Gross weight	82,000 lb.	~ 33,000 lb.	39,000 lb.	64,500 lb.	72 500 lb.	37 500 lb.	~ 128,000 lb.	53,200 lb.
Max. payload (capacity limited)	27,800 lb.	10,990 lb.	13,300 lb.	11,800 lb.	14,500 lb.	9,200 lb.	~ 29,000 lb.	11,690 lb.
Max. fuel capacity (volume)	3,300 Imp.gals	1,100 Imp.gals	1,080 to 1,740 Imp.gals	1,967 Imp.gals	1,907 Imp.gals	13,000 lb.[9] 1,137 Imp.gals	33,000 lb. —	13,178 lb.[11] 2,032 U.S.gals
Max. landing weight	78,000 lb.	~ 33,000 lb.	38,500 lb.	57,500 lb.	62,000 lb.	35,700 lb.	—	50,670 lb.
Passenger capacity (tourist class)	83	up to 44 (or freight)	38—47 (also pure freight)	53—63	60—70	up to 48	80—100	48/58
Passenger capacity (first class)	—	—	—	44	52/56[6]	—	73	—
Total hold capacity	gross 3680 cu. ft.	~ 210 cu.ft. 40-pass. layout	402 cu.ft. with 38 pass.	358 cu.ft.	370 cu.ft.[6] without lounge	177—355 cu.ft. 32 or 40 seater	—	402 cu.ft.
Max. cruising speed	257 kn	—	243 kn	283 kn	317 kn	—	~ 390 kn	—
Recommended cruising speed	239 kn	~ 230 kn	238 kn	270 kn[5]	302 kn[7]	233/237 kn	~ 350 kn	273 kn
(at indicated cruising altitude)	—	(20,000′)	(15,000—20,000′)	—	—	263/266 kn (20,000′)	—	(20,000′-46,000 lb.)
Average cruising altitude	—	—	—	20,000′	20,000′	—	~ 25,000′	~ 20,000′
CAR runway length at max. take-off weight — sea level (ICAN)	4,050′	2,520′ Take-off run	4,200′	5,450′	5,950′	3,450′/4,760′[10]	—	4,700′
CAR landing run at max. landing weight–sea level (ICAN)	2,920′	2,310′ Landing run	3,550′	4,860′	5,250′	3,650′	—	4,330′
Typical still air range	435 n.m. (27,000 lb.)	190 n.m. (9,670 lb.)	770 n.m. (10,160 lb.) 1,520 n.m. (6,200 lb.)	1,130 n.m. (11,800 lb.)	1,120 n.m. (14,500 lb.)	240 n. m. (13,000 lb.) R.Da.6	~ 1,100 n.m. (29,000 lb.)	780 n.m. (10,800 lb.) (48 pass.) (11,600 lb.)
(for indicated payload)	1,480 n.m. (15,000 lb.)	40 pass. plus freight and reserves 1,600 n.m. without reserves	38-seat pass. version; 450 n.m. with max. payload (freight version)	1,320 n.m. (max. range with normal reserves)	1,140 n.m. (max. range with normal reserves)	230 n. m. (12,500 lb.) R.Da.7 max. 1,400 n.m. (5,510 lb.) with R.Da.6 max. 1,340 n.m. (5,000 lb.) with R.Da.7	max. ~ 2,700 n.m.	680 n.m. (58 Pass.) max. 1,300+ n.m. (5,500+ lb.)

1 Also **Britannia** Series 310 and 300, both with four Bristol **Proteus 755s** of 4,120 e.h.p. each. **Britannia 310** with 175,000 lb. **Britannia 300** with 160,000 lb gross weight. 2 Assuming cruising rev. speed (13,500 r.p.m.) recommended by engine manufacturers, and typical cruising weight for a stage of 500 nautical miles with normal reserves. 3 CL-44D-4 available in three versions: freighter, passenger transport, mixed passenger/cargo aircraft. Military transport version for RCAF is CC-106. Max. cruising speed approx. 340 knots at 20,000+ ft. and 135,000 lb. zero fuel weight. 4 Other versions AW.651 **(two Tynes)**, AW.660 (military, four **Darts**), AW.661 (military, two **Tynes**), AW.670 (air ferry) and AW.671 (air bus). 5 At 13,800 r.p.m. recommended by engine manufacturers for cruising, and typical cruising weight for 300 nautical miles with normal reserves. 6 Extra four passengers in lounge; total freight capacity in this case reduced by 120 cu.ft. 7 Cruising rev. speed recommended by engine manufacturers 14,000 r.p.m.; otherwise conditions as under 5. 8 **Friendship** also built under licence by Fairchild, USA. 9 Payloads given: 9,200 lb. = capacity limited (cabin for 40 passengers); 13,000 lb. = weight limited. Corresponding payloads for R.Da.7 version 9,200 lb. and 12,500 lb. 10 CAR (SR 422) take-off distance (with one engine cut), for both versions with R.Da.7 and R.Da.6. 11 Weight-limited payload.

Medium and Long-Range Jet Transports

Aircraft Type	Vickers VC.10	Boeing 707-120[12]	Boeing 707-220	Boeing 707-320 Intercontinental	Boeing 707-420 Intercontinental	Douglas DC-8[14] Domestic
COUNTRY	**GREAT BRITAIN**	**USA**				
Engines (number and type) Max. sea level take-off rating	4×Rolls-Royce Conway R.Co.42 4×21,000 lb.	4×Pratt & Whitney JT3C-6 4×12,000/13,000 lb.	4×Pratt & Whitney JT4A-3 4×15,800 lb.	4×Pratt & Whitney JT4A-5 4×15,800 lb.	4×Rolls-Royce Conway 505 4×17,500 lb.	4×Pratt & Whitney JT3C-6 4×12,000/13,000 lb.
Wing span Length Wing area	140′ 158′ 10″ 2,800 sq.ft.	130′ 10″ 144′ 6″ 2,433 sq.ft.	130′ 10″ 144′ 6″ 2,433 sq.ft.	142′ 5″ 152′ 11″ 2,892 sq.ft.	142′ 5″ 152′ 11″ 2,892 sq.ft.	139′ 9″ 150′ 6″ 2,758 sq.ft.
Gross weight Max. payload (capacity limited)	299,000 lb. 38,000 lb.	248,000 lb. 42,000 lb.	248,000 lb. 42,000 lb.	316,000 lb.[13] 42,600 lb.	316,000 lb. 42,600 lb.	265,000 lb. 33,040 lb. 37,165 lb.
Max. fuel capacity (volume)	17,250 Imp.gals	17,398 U.S.gals 13,478 U.S.gals	17,398 U.S.gals 13,478 U.S.gals	23,600 U.S.gals 21,350 U.S.gals	23,600 U.S.gals 21,350 U.S.gals	17,600 U.S.gals
Max. landing weight	197,500 lb.	175,000 lb.	175,000 lb.	189,000 lb.	189,000 lb.	189,000 lb.
Passenger capacity (tourist class) Passenger capacity (first class) Total hold capacity	145–151 119 1,450 cu.ft.	179 121 1,600 cu.ft.	179 121 1,600 cu.ft.	189 131 1,700 cu.ft.	189 131 1,700 cu.ft.	up to 176 118 1,415 cu.ft.
Max. cruising speed	544 kn	495–520 kn	505–525 kn	500–525 kn	500–525 kn	~500 kn 30 000′ at 220,000 lb.
Recommended cruising speed (at indicated cruising altitude)	500 kn —	— —	— —	— —	— —	—
Average cruising altitude CAR runway length at max. take-off weight—sea level (ICAN) CAR landing run at max. landing weight—sea level (ICAN)	38,000′ 7,350′ 6,400′	30,000–40,000′ 10,200′ CAR SR 422 5,980′	30,000–40,000′ lower than 707-120 figures dito	30,000–40,000′ 10,150′ 6,850′	30,000–40,000′ — —	30,000–40,000′ 9,170′ 6,680′
Typical still air range (for indicated payload)	4,470 n.m. (38,000 lb.) max. 4,880 n.m.	3,000 n.m. (32,000 lb.)	2,875 n.m. (32,000 lb.)	4,000 n.m. (34,000 lb.)	4,000+ n.m. (34,000 lb.)	2,030 n.m. (6,500′-runway) 1st class layout max. 3,300 n.m.

12 707-120B version with P&W JT3D-1 turbofan engines of 17,000 lb. or 18,000 lb. thrust; gross weight 258,000 lb.; max. landing weight 185,000 lb.; max. payload 49,270 lb. **13** Max. permissible gross weight; PAA's 707-320s are at present certificated for a gross weight of 302,000 lb.



Boeing 707-320 · Douglas DC-8 · Convair 880 · Convair 600 · Tupolev Tu-110

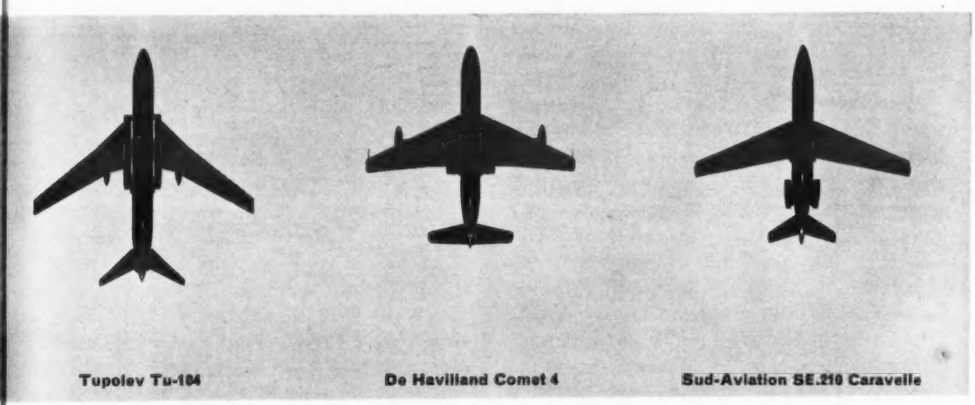
Medium and Short-Range Jet Transports

Aircraft type	Airco DH.121	Bristol 205	de Havilland Comet 4[15]	de Havilland Comet 4B	Hunting 107	Sud-Aviation SE.210 Caravelle I	Sud-Aviation SE.210 Caravelle III	Sud-Aviation SE.210 Caravelle VI	Sud-Aviation SE.210 Caravelle VII
COUNTRY	**GREAT BRITAIN**					**FRANCE**			
Engines (number and type)	3×Rolls-Royce RB 163	Bristol Siddeley ducted fans	4×Rolls-Royce Avon RA.29-1	4×Rolls-Royce Avon RA.29-1	2×Bristol Orpheus or 2×ducted fan engines 2×	2×Rolls-Royce Avon RA.29-1 Mk.522 or Mk.526	2×Rolls-Royce Avon RA.29-3 Mk.527	2×Rolls-Royce Avon RA.29-6 Mk.531	2×Rolls-Royce RB.141-3
Max. sea level take-off rating	3×10,100 lb.	—	4×10,500 lb.	4×10,500 lb.	~5,500/6,500 lb.	2×10,500 lb.	2×11,400 lb.	2×12,200 lb.	2×13,970 lb.[19]
Wing span Length Wing area	89′ 10″ 104′ 1,350 sq. ft.	— — —	115′ 111′ 5″ 2,121 sq. ft.	108′ 118′ 2,059 sq. ft.	80′ 77′ 9″ 800 sq. ft.	112′ 6″ 105′ 1,582 sq. ft.	112′ 6″ 105′ 1,582 sq. ft.	112′ 6″ 105′ 1,582 sq. ft.	112′ 6″ 105′ 1,582 sq. ft.
Gross weight	105,000 lb.	—	162,000 lb.	158,000 lb.	~45,000 lb.	95,900 lb.	99,200 lb.	103,620 lb.	110,230 lb.
Max. payload (capacity limited)	21,500 lb.	—	20,286 lb.[16] 16,800 lb.[17]	24,612 lb.[16] 19,630 lb.[17]	~10,000 lb.	18,740 lb.[18]	18,520 lb.[18]	18,300 lb.[18]	18,740 lb.[18]
Max. fuel capacity (volume)	3,840 Imp. gals	—	8,900 Imp. gals	7,800 Imp. gals	—	4,070 Imp. gals	4,070 Imp. gals	4,070 Imp. gals	4,070 Imp. gals
Max. landing weight	100,000 lb.	—	120,000 lb.	120,000 lb.	—	18,790 lb.	19,440 lb.	20,300 lb.	104,940 lb.
Passenger capacity (tourist class) Passenger capacity (first class)	97 (Economy) 79/83 (mixed class)	70 (?) —	76/81 60	102 72	44/48 —	72/80 64	72/80 64	72/80 64	72/80 64
Total hold capacity	620 cu.ft.	—	545 cu.ft.	545 cu.ft.	—	396 cu.ft.	396 cu.ft.	396 cu.ft.	396 cu.ft.
Max. cruising speed Recommended cruising speed (at indicated cruising altitude)	520+ kn ~510 kn (32,000′)	— — —	— ~440 kn —	— 460 kn —	up to 450 kn 400 kn —	403 kn 390 kn (32,800′)	428 kn 412 kn (35,000′)	451 kn 419 kn (37,000′)	471 kn 442 kn (38,000′)
Average cruising altitude CAR runway length at max. take-off weight—sea level (ICAN) CAR landing run at max. landing weight—sea level (ICAN)	25,000–35,000′ 6,000′ —	— — —	28,000–40,000′ ~6,400′ ~3,500′	~20,000–38,000′ ~6,400′ ~3,500′	— — —	30,000–40,000′ 5,970′ 5,315′	30,000–40,000′ 5,870′ 5,530′	30,000–40,000′ 6,100′ 5,840′	30,000–40,000′ 6,000′ 6,270′
Typical still air range (for indicated payload)	~170–1,050 n.m. (21,500-16,000 lb.)	—	2,800 n.m. (16,800 lb.)	2,230 n.m. (19,630 lb.)	~700–900 n.m. (at 10,000 lb.)	890 n.m./366 kn (18,300 lb.)	1,070 n.m./383 kn (18,300 lb.)	1,330 n.m./395 kn (18,300 lb.)	1,970 n.m./426 kn (18,300 lb.)

15 Also "Intermediate" **Comet 4C** for 72 to 102 passengers with ranges approaching those of the **Comet 4**. Projected **Comet 5** will have increased performance and larger capacity. **16** Tourist class. **17** First class. **18** Max. payload for standard version.

Douglas DC-8[14] Domestic	Douglas DC-8[14] Intercontinental	Douglas DC-8[14] Intercontinental	Douglas DC-8[14] Intercontinental	Douglas DC-8[14] Intercontinental
USA				
4×Pratt & Whitney JT4A-3 4×15,800 lb.	4×Pratt & Whitney JT4A-3 4×15,800 lb.	4×Rolls-Royce Conway 4×17,500 lb.	4×Pratt & Whitney JT4A-9 4×16,500 lb.	4×Rolls-Royce Conway R.Co.12 4×17,500/18,500 lb.
139′ 9″ 150′ 6″ 2,758 sq.ft.	139′ 9″ 150′ 6″ 2,758 sq.ft.	139′ 9″ 150′ 6″ 2,758 sq.ft.	139′ 9″ 150′ 6″ 2,758 sq.ft.	139′ 9″ 150′ 6″ 2,758 sq.ft.
265,000 lb. 33,040 lb. 37,165 lb. 17,600 U.S.gals	287,500 lb. 35,680 lb. 37,165 lb. 21,615 U.S. gals	287,500 lb. 35,680 lb. 37,165 lb. 21,615 U.S.gals	310,000 lb. 35,680 lb. 37,165 lb. 23,307 U.S.gals	310,000 lb. 35,680 lb. 37,165 lb. 23,307 U.S.gals
189,000 lb.	194,000 lb.	194,000 lb.	199,500 lb.	199,500 lb.
up to 176 118 1,415 cu.ft.	up to 176 132 1,415 cu.ft.	up to 176 132 1,415 cu.ft.	141/176+ 132 (?) —	141/176+ 132 (?) —
~510 kn 30,000′ at 220,000 lb. —	~510 kn 30,000′ at 220,000 lb. —	~515 kn 30,000′ at 220,000 lb. —	~515 kn 30,000′ at 220,000 lb. —	~515 kn 30,000′ at 220,000 lb. —
30,000–40,000′ 7,320′	30,000–40,000′ 8,430′	30,000–40,000′ 8,470′	30,000–40,000′ 9,220′	30,000–40,000′ 9,050′
6,630′	6,850′	6,850′	7,100′	7,100′
3,220 n.m. (6,500′-runway) 1st class layout max. 3,560 n.m.	2,810 n.m. (6,500′-runway) mixed class max. 3,910 n.m.	2,930 n.m. (6,500′-runway) mixed class max. 4,060 n.m.	4,280/4,370 n.m. max. ~5,900 n.m.	4,430/4,520 n.m. max. ~5,900 n.m.

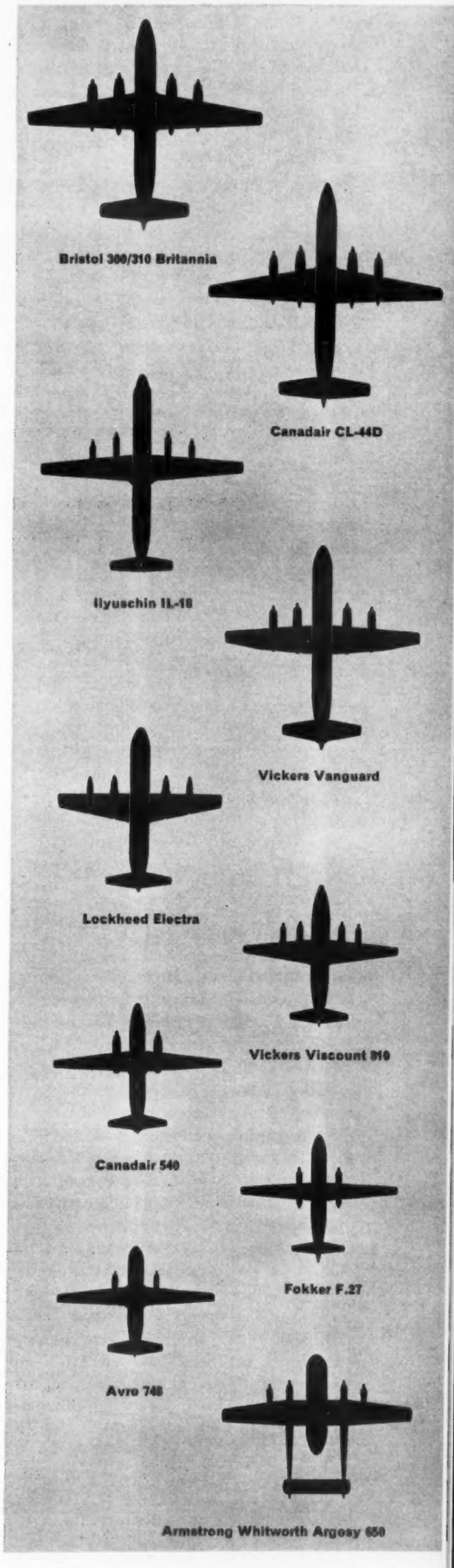
14 Final figures for all DC-8 versions will not be available until flight testing is completed.



Tupolev Tu-104 — De Havilland Comet 4 — Sud-Aviation SE.210 Caravelle

Dresden Aircraft Works Type 152-II	Tupolev[22] Tu-104A	Tupolev Tu-110	Boeing 720[23]	Convair 880-22 (Domestic)	Convair 880-31 (Overwater)	Convair 600-30 (Overwater)	Douglas DC-9
EAST GERMANY	**SOVIET UNION**		**USA**				
4×Pirna 014	2×Mikulin/ Zubetz AM-3	4×Lulko	4×Pratt & Whitney JT3C-7	4×General Electric CJ-805-3	4×General Electric CJ-805-3	4×General Electric CJ-805-23	4×Pratt & Whitney JTF10A-1
4×6,950 lb.	2×14,850 lb.	4×~11,000 lb.	4×12,000 lb.	4×~11,000 lb.	4×~11,000 lb.	4×~16,000 lb.	4×8,250 lb.
88′ 7″ 103′ 0″ 1,485 sq. ft.	114′ 10″ 123′ 0″ 2,024 sq.ft.	123′ 125′ 8″ ~2,100 sq.ft.	130′ 10″ 136′ 2″ 2,433 sq.ft.	120′ 0″ 124′ 2″ 2,000 sq.ft.	120′ 0″ 124′ 2″ 2,000 sq.ft.	120′ 0″ 134′ 9″ 2,250 sq.ft.	94′ 0″ 103′ 0″ 1,285 sq.ft.
98,100– 102,500 lb.[20] ~13,230– 19,840 lb.	~154,000 lb. 16,500–22,000 lb.	~170,000 lb. 26,500 lb.	203,000 lb. 34,400 lb.	184,500 lb. 27,000/23,500 lb. weight/capacity limited	203,400 lb. 30,000/23,500 lb. weight/capacity limited	239,200 lb. 30,000/27,000 lb. weight/capacity limited	120,000 lb. 17,310 lb.[24] 20,355 lb.[24]
4,060 Imp. gals	7,480 Imp. gals	—	13,550 U.S.gals 11,500 U.S.gals	10,770 U.S. gals	13,870 U.S. gals	15,670 U.S. gals	6,230 U.S. gals
89,290 lb.	—	—	165,000 lb.	132,800 lb.	155,000 lb.	180,000 lb.	98,000 lb.
72 48/57	70 50	100 50/78	140 110	— 88	— 38+54 (1st class/ economy)	— 38+69 (1st class/ economy)	72/92 68
385 cu.ft.	—	—	1,340 cu.ft.	863 cu.ft.	863 cu.ft.	928 cu.ft.	609 cu.ft.
— 430 kn	— 430 kn	— ~430 kn	— 500–535 kn	534 kn Mach 0.82	534 kn Mach 0.82	551 kn Mach 0.86	510+ kn 450–500 kn
~30,000-40,000′ 4,265′ (102,500 lb.)	~25,000′ ~5,000′	~30,000-40,000′ —	up to ~40,000′ ~7,000′	30,000–40,000′ 7,700′	30,000–40,000′ 10,000′	30,000–40,000′ 8,100′	25,000–35,000′ 6,020′
~4,600′[21] (77,160 lb.)	~3,900′	—	~5,500–6,000′	5,600′	5,200′	5,000′	~5,200′
1,100– 1,700 n.m.	1,700 n.m. (?)	~1,800 n.m. (26,500 lb.)	2,150 n.m. (30,000 lb.)	2,500 n.m. (23,500 lb.)	3,050 n.m. (23,500 lb.)	3,400 n.m. (27,000 lb.)	1,970 n.m. (17,310 lb.)

19 Rolls-Royce states that the RB.141 will reach thrusts of 16,000 to 19,000 lb. in the course of development. 20 With an overload take-off weight of 105,800 lb., range (48 passengers) can be increased to a maximum of 1,670 nautical miles. 21 Take-off distance to clear a 35-ft. obstruction (ICAO) and landing distance from 50 ft. 22 Other sources give a thrust of 18,700 lb. for the 104A and a gross weight of over 154,000 lb. Version Tu-104B for 100 passengers or a payload of 26,500+ lb. The Tu-104B has a cruising speed of 430 to 480 knots; cruising altitudes 33,000 to 40,000 ft. 23 Boeing 720B version with P&W JT3D-1 turbofan engines; gross weight 222,000 lb.; slightly better performance than 720 version. 24 Weight-limited payload.



Bristol 300/310 Britannia — Canadair CL-44D — Ilyuschin IL-18 — Vickers Vanguard — Lockheed Electra — Vickers Viscount 810 — Canadair 540 — Fokker F.27 — Avro 748 — Armstrong Whitworth Argosy 650

The Case for the Supersonic Transport

By Hall L. Hibbard and Robert A. Bailey,
Lockheed Aircraft Corporation,
Burbank, California

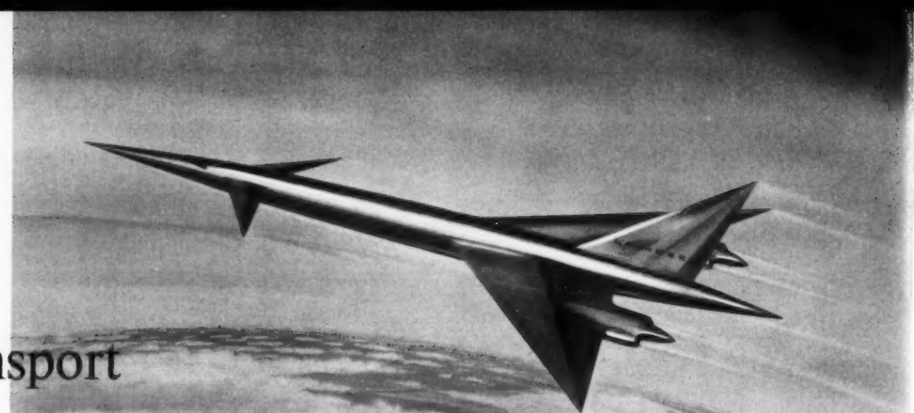


Fig. 1: Lockheed design for a "canard"-type four-jet supersonic transport for 80 to 90 passengers.

The views of leading men from Convair, Boeing and Douglas on the probable configuration of future supersonic transports and on supersonic traffic operations were given in a recent issue of Interavia. *At that time, however, the voice of Lockheed was absent, and the Editors therefore welcome the opportunity to publish the following paper by Hall. L. Hibbard, Lockheed Senior Vice President, and Robert A. Bailey, Chief Engineer of the company's California Division.* *Editors*

To us at Lockheed, and to other leading American commercial transport manufacturers, it seems probable that a supersonic commercial transport could commence operations on the world's airlines between 1965 and 1967.

The two determining questions—"Can we build such a transport?" and "Can the airlines finance its purchase?"—can both be answered affirmatively. The principal remaining item is the exact date of first scheduled timetables. Our own research indicates that the period just following 1965 could be a most reasonable estimate, providing a firm decision to start the project were made this year.

We settle on this time period for two reasons. An analysis of the development time spans for all significant transports introduced in the last 15 years shows an average of 4.8 years to full aircraft certification after completion of the engine development program. Scheduling studies indicate that similar time spans will be required for development of the supersonic transport. There is no reason to believe that we could not commence to deliver such a transport in 1965.

The question of whether the airlines will be in a financial position to introduce it into service this early is one that is subject to more doubt. Our own analyses, however, indicate that they will be. An estimate of the capital available to the airlines made up of the 1958 equity base, depreciation of current equipment, and retained earnings shows that if a supersonic transport were to commence operations in 1965 the amount of outside financing required would be less than that required for current financing of the subsonic jet fleet. Furthermore, our studies show that expected volume of traffic would support a new transport commencing operations in the 1965 to 1967 time period.

We are not alone in this belief. T. Carl Wedel, vice president of the First National City Bank of New York and a leading world financier of airline equipment, recently stated that the supersonic transport will be here "well before 1970" and that "if the initial years of the jet age prove at all financially and operationally successful, there is no reason to assume that lenders would not again be willing to consider at least matching dollar for dollar the airlines' equity—so the potential for borrowing additional funds should definitely exist in the 1960's."

With the likelihood that the supersonic transport will make its appearance in the last half of the next decade, interest naturally centers on what it will look like and how it will perform. We at Lockheed have gained a wealth of experience in supersonic flight with the USAF F-104 *Starfighter,* holder of world speed, altitude, climb and acceleration records. In addition, we have devoted a great deal of study, analysis, and wind tunnel and laboratory testing to the supersonic transport. From this experience and research we have gained a rather clear picture of what the supersonic transport will be like.

In appearance it will be radically different from the piston and jet engine aircraft now flying (see *Fig. 1*). Perhaps its most outstanding feature will be its "canard" arrangement—an arrangement in which the horizontal tail will be located far forward on the fuselage, with the trapezoidal wing to the rear. Although other wing-body configurations are certainly possible, the reversal of the conventional wing and tail positions appears to have the greatest advantage, particularly in the reduction of "trim-drag" penalties associated with supersonic flight. Span of the wing itself will be less than in current transports.

We believe the supersonic transport should and will cruise at 2,000 to 2,200 miles an hour. The lower direct operating cost, the improved block speed, and the long term growth potential of an aircraft cruising at this speed leave little reason for consideration of a slower design speed. Research studies (see *Fig. 2*) currently show that aircraft flight efficiency measured in miles per gallon of fuel reaches a subsonic maximum between Mach 0.8 and 0.9, drops rapidly to unattractive values between Mach 1.0 and 2.0, but returns to values higher than

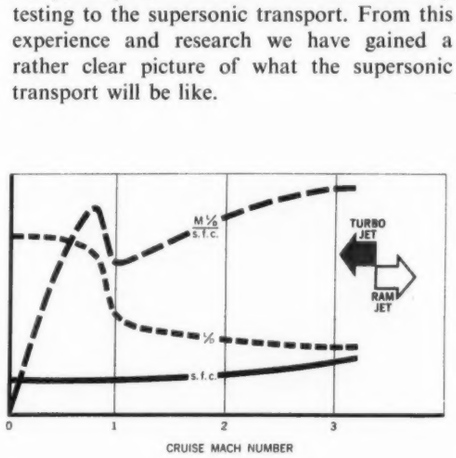


Fig. 2: Cruise efficiency and Mach number: On the basis of the Breguet "range formula" which states that an aircraft's maximum range is directly proportional to the product of cruising Mach number (M) and optimum L/D ratio, but inversely proportional to specific fuel consumption (s.f.c.), a parameter is formed from these three variables and plotted as ordinate against Mach number. The parameter shows its first maximum at roughly Mach 0.8, falls in the transonic range, but rises again with increasing Mach number to a level above that of the subsonic maximum. Turbojets are recommended up to roughly Mach 3.4, then ramjets.

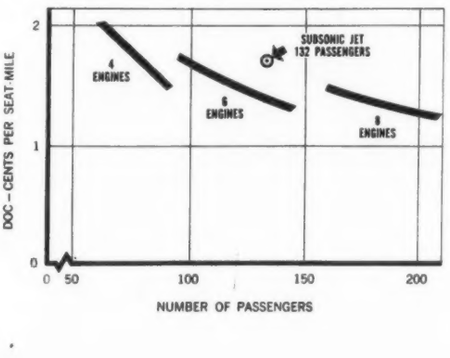


Fig. 3: Direct operating cost (in cents per seat-mile) versus seating capacity in three different types of supersonic transport, assuming a block distance of 3,300 nautical miles and an annual utilization of 3,000 hours. For purposes of comparison the operating costs of a subsonic 132-passenger aircraft are also shown. Lockheed gives first preference to the four-jet type for a maximum of 90 passengers, as being most adaptable to varying stage requirements and traffic frequencies.

those at subsonic speeds in the Mach 3.0 and 3.5 range. Cruising at this latter speed at 70,000 to 75,000 feet, the supersonic airliner will actually fly farther on a gallon of fuel than current subsonic types flying one fourth as fast.

How about higher speeds? While these speeds are interesting from the technical standpoint, propulsion difficulties indicate that a cruise speed substantially higher will not be feasible until the 1970s. At present there is no comparable development of air breathing propulsion systems for hypersonic flight.

But the supersonic aircraft flying at Mach 3.0 will be a tremendous advance over present transports. It will out-distance the sun in westbound operations. A passenger leaving London at 11:00 a.m. would arrive in New York at 8:20 the same morning. A passenger leaving New York at noon would arrive in Los Angeles at 10:50 a.m. Time from New York to Los Angeles will be approximately one hour and 15 minutes.

The supersonic transport will be constructed of stainless steel and titanium alloys. Temperature of the air passing over the aircraft will be between 500 and 600 degrees Fahrenheit, more than twice the temperature of boiling water. At these temperatures conventional aluminium alloys used in subsonic aircraft would be inadequate. As far as manufacturing techniques go, we believe that the relatively conventional skin and stiffener panel construction should be used for most of the important structural elements. The "honeycomb" sandwich technique may, however, be used on inlets, ducts, and wing leading edges.

Engines may be either the turbojet or ramjet type, using kerosene type fuel. Present indications are, however, that conventional turbojet engines will be used because of the military development experience backing them and because of their more conventional operating characteristics. Such engines have been under development for several years, are currently running on the test stands and will be tested in flight soon. Our studies show that a non-afterburning engine will prove superior for a transport aircraft, but the decision between afterburning and non-afterburning engines may be dictated by the size of the aircraft and the preference of airline operators.

Many tests have been conducted on engine location as shown in *Fig. 4*. Everything considered, the twin nacelle arrangement seems best.

With respect to size, we strongly believe that the supersonic vehicle may be smaller than has been previously described* and, in fact, smaller than comparable subsonic jet transports flying today, thus bringing to at least a temporary halt the historic trend toward increased size and weight in commercial airline equipment.

* cf. "Convair, Boeing, Douglas... and Seven Questions on Supersonic Transports", in *Interavia* No. 5, 1959, pp. 515 to 516.

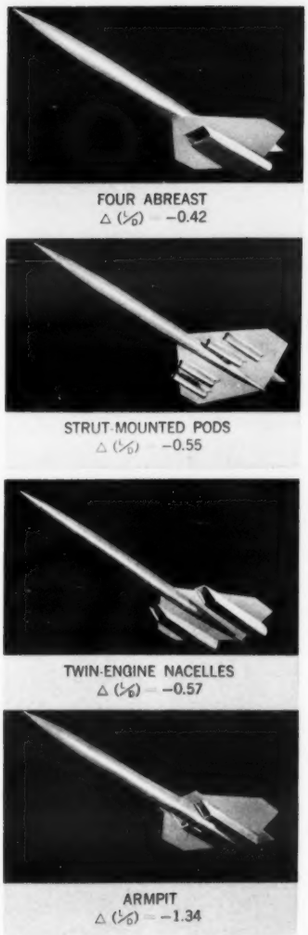


Fig. 4: Wind tunnel tests on four different engine layouts supplied information on probable losses in optimum L/D radio in supersonic flight. Although the third layout (twin-engine nacelles) is aerodynamically less favourable than the first two, it is preferred for structural and operational reasons.

Direct operating cost per seat mile favors the larger aircraft; but a complete analysis of airline operations, using three different sizes of supersonic transports ranging from 80 to 220 passengers, leads us to believe that cost per seat mile alone is not a suitable measure of profitable operation for the supersonic airliner *(Fig. 3)*. It appears that the additional frequency of service, flexibility of operation, and daily utilization obtainable from aircraft in the 80 to 90 passenger class favors the smaller vehicle.

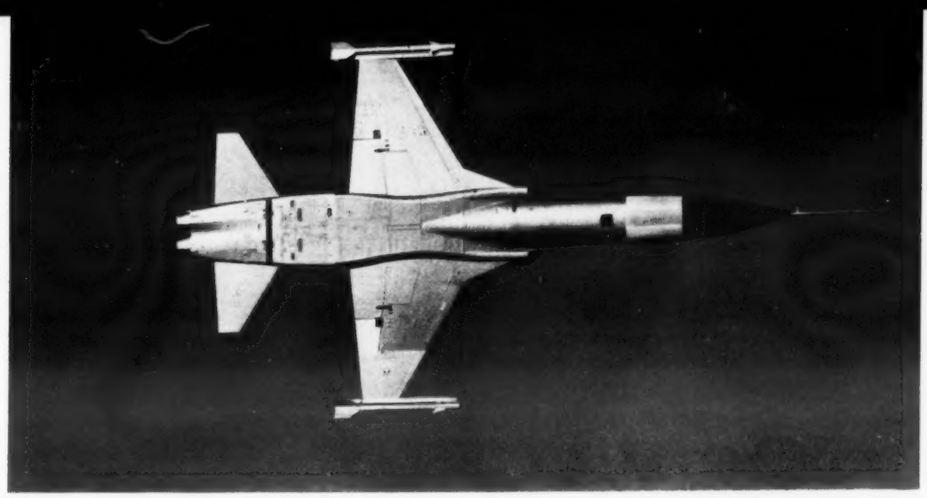
To be sure, there are special problems involved in commercial supersonic flight, but there are none that will not yield to solution. For example, despite high outside temperatures of flight, it is possible to maintain a completely comfortable cabin temperature without undue penalty in weight and complexity of design. We have tested a large full scale specimen of a typical cabin wall design incorporating the outside steel skin, an insulation blanket of glass fiber, and a molded plastic interior trim through which cooling air was continously circulated. By using this system, the interior cabin trim can be kept at 70 degrees Fahrenheit while the outside skin is at 600 degrees Fahrenheit. Window cooling can be accomplished through the use of multiple panes and inter-pane cooling. Such a system can be installed for the same percentage of gross weight as the Lockheed *Electra* system. It shows good promise of reliability and reasonable maintenance and appears to pose no unusual problems.

The airport noise problem, troublesome in the case of the subsonic jet transport, may well be less of a problem with the supersonic aircraft. On the ground, the supersonic jet transport, on the take-off roll, will have a slightly higher noise level primarily because of its higher thrust. But since the supersonic jet has a much steeper climbout path, noise levels affecting the community around the airport will be somewhat lower, even without a noise suppressor. Chances are very good that a noise suppressor can be completely eliminated, thus providing important performance gains. Whether or not the suppressor can be omitted depends very largely on the public's willingness to accept the normal tone of the jet engine as a part of the modern scene, just as it has accepted the locomotive whistle.

Another problem is that of the sonic boom produced on the ground when the supersonic transport flies overhead. It is a problem that will be of most concern during climb and descent, since current indications are that the supersonic transport will be operating at cruising altitudes well outside regions in which objectionable sonic boom exists. Additional work remains to be done on this problem, but our studies show that the problem can be controlled and avoided to a reasonable degree by maintaining moderate speeds during climb and descent.

It is encouraging to note that, apart from its use as a commercial carrier, the supersonic transport has application to many military purposes. The vehicle is suited to meet a variety of military objectives in an era in which brushfire wars and other considerations dictate a need for rapid reaction and flexibility. Its speed and favorable operating economics give promise of use as a high speed logistics carrier. Other applications to military purposes include reconnaissance missions and special air missions. These military uses suggest the possibility of substantial military support for the program that would ease the airlines' burden of financing.

To summarize, we believe the supersonic transport is completely feasible in that all technical and operational factors can be successfully treated with respect to the current state of the art. We know we can build such an airplane and that, if we were to begin now, we could meet a certification target date of 1965. This date, we believe, is realistic to meet the expanding airline market and is a practical one from the standpoint of airline financing and engine availability.



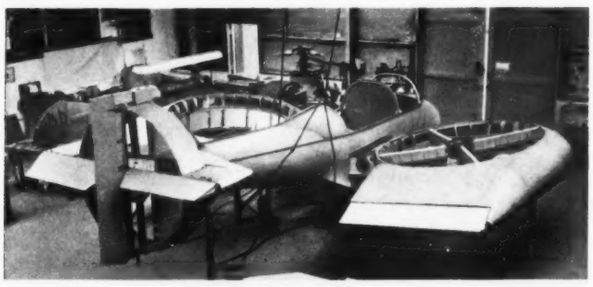
Flight testing the Northrop N-156F: *With two Philco* Sidewinder *air-to-air missiles at its wingtips, the prototype of the N-156F* Freedom Fighter *goes into a slow roll. Barely three weeks after its maiden flight from the Flight Test Center at Edwards Air Force Base, California, the N-156F was able to make test flights carrying various external weapons. The prototype is powered by two de-rated General Electric J85-1 jet engines without reheat, which deliver only about half the thrust of the J85-5 reheat version planned for the production model. The new engines, each with about 3,850 lb. of reheat thrust, should be available by about October.*

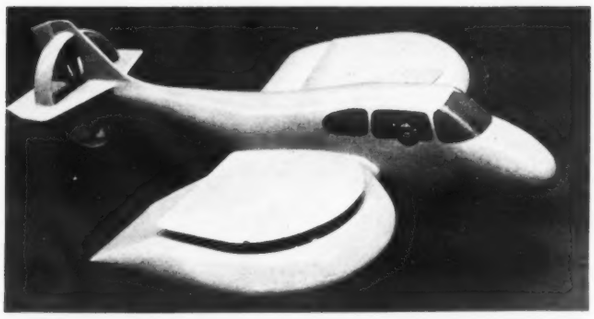
Progress in Pictures

Piper Tri-Pacer: *Streamlined wheel-spats, which are optional equipment in this four-seat touring aircraft, increase the cruising speed of the 1960 version of the* Tri-Pacer *to 138 m.p.h. Landing speed is less than 50 m.p.h. Powered by a 160 h.p. Lycoming engine, the aircraft will climb fully-loaded at a rate of over 800 f.p.m. Range with normal fuel supply is 530 miles, with auxiliary fuel tanks over 650 miles. Three versions are announced for 1960, including the* AutoFlite, *fitted with the* AutoControl *developed by Piper. Price of the standard version is $ 9,340; the* Auto-Flite *model costs $ 11,970.*

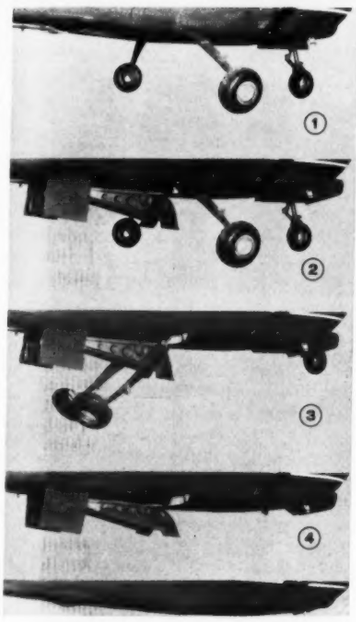
Vanguard Model 2C VTOL aircraft: *Vanguard Air & Marine Corporation, of Paoli, Pennsylvania, is experimenting with a new way of solving the problem of vertical take-off, in the shape of the Model 2C, whose prototype will be nearing completion as these lines go to print. As shown in the pictures, the VTOL design has two rotors set into cushion-shaped wings to produce lift for vertical flight and hovering, while forward propulsion will be supplied by a ducted fan in the tail. During cruising flight the cover plates over the round rotor openings and the louvre-type doors underneath the wing (not shown here) will be closed. The manufacturers give the following data for the aircraft, which will be a two-seater powered by a 265 h.p. Lycoming 0-540-A1A engine: wing span 22 ft.; length 25 ft. 6 in.; wing area 210 sq.ft.; diameter of wing rotors 6 ft. 6 in.; diameter of tail rotor 5 ft.; weight equipped 1,700 lb.; gross weight about 2,200 lb. The performance figures calculated by the manufacturers are: max. speed 165 knots; cruising speed 143 knots; rate of climb in vertical flight 500 f.p.m.; endurance approximately 1 hour.*

Beside the Model 2C, Vanguard has prepared a series of other projects, all of which use the same lift and propulsion principle. These include a four-seat touring aircraft, an assault transport and an unmanned reconnaissance and surveillance aircraft.



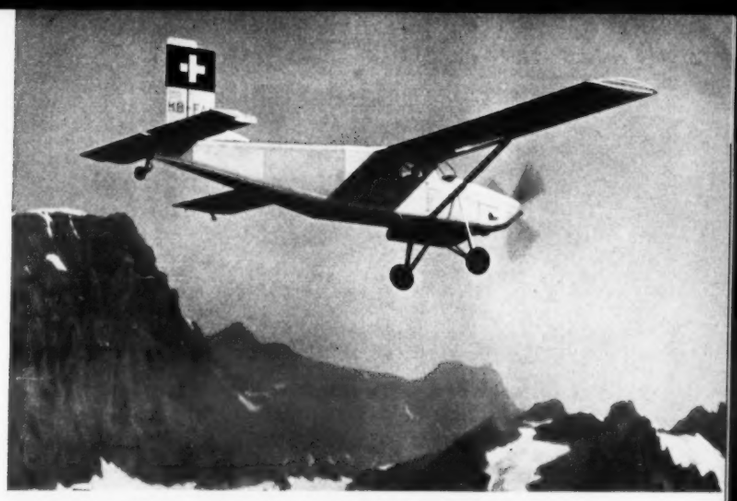


"Five-engined" Boeing 707: *A few weeks ago a Qantas Empire Airways Boeing 707 took off from Boeing Field, Seattle, with a standby engine in a special container under its left wing. The strut for the container, known as the* Pod-Pak, *is fixed to the aircraft's front wing spar and secured to a reinforced rib which also partially supports the main undercarriage struts. The use of the* Pod-Pak *requires no structural changes in the aircraft's wing, and container and strut can be easily fitted and removed. Flight tests have confirmed that carrying the* Pod-Pak *does not affect flying qualities and does not substantially alter performance.—Use of the system will do away with the need for stocks of spare engines at any but the major airports along an airline's routes. Eight airlines in addition to Qantas have ordered the* Pod-Pak *for their Boeing 707s.*



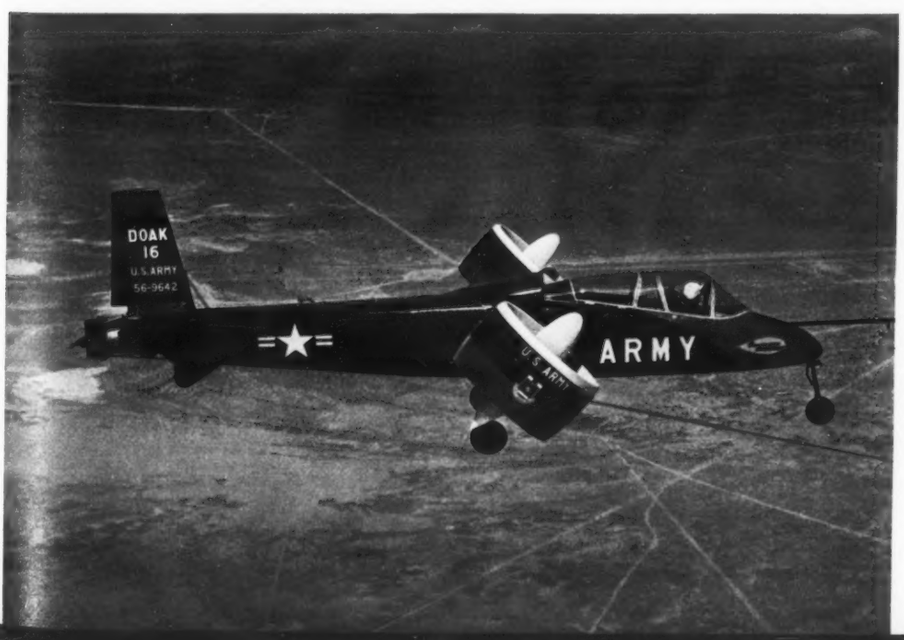
Cessna 210: *The accompanying pictures show the retraction sequence of the sprung landing gear for the Cessna Model 210 touring four-seater, powered by a 260 h.p.* Continental *10-470-E engine, offered for sale at a price of $ 22,450 (without radio or navigation equipment). With the undercarriage down and secured in position (1) all covers are closed. As retraction begins the doors open (2) and the main undercarriage members swing backwards through about 90° into the fuselage (3). After retraction (4) the doors close and the fuselage belly becomes an aerodynamically smooth surface.*

Further data on the Cessna 210: wing span 36.5 ft.; length 26.4 ft.; wing area 175.5 sq.ft.; gross weight 2,900 lb.; cruising speed at 6,900 to 7,800 ft. 165 kn; max. speed 172 kn; max. range 950 n.m.



The Pilatus Porter at 27,000 ft.: *During its flight trials the* Porter *light transport and multipurpose aircraft, built by Pilatus Aircraft Works, Stans, reached the impressive altitude of 27,320 ft. with a take-off weight of 3,307 lb. At its maximum gross weight of 3,968 lb. the* Porter *reached a height of 23,950 ft. Data for the all-metal high-wing aircraft, powered by a 340 h.p. Lycoming GSO-480 engine: span 49.9 ft.; length 34.8 ft.; wing area 306.8 sq.ft.; cruising speed 108 kn; rate of climb with full load 1,140 f.p.m.; take-off run at max. take-off weight approx. 330 ft.; landing speed 38 knots. Cabin space from the back of the pilot's seat to the rear end of the cabin is 7.9 ft. long and 3.8 ft. wide. The floor of the loading space has a 23.6×35.4 inch hatch for load-dropping or mounting a camera.*

The Doak Model 16 experimental VTOL aircraft *with ducted swivel rotors, built for the U.S. Army under the designation VZ-4DA by the Doak Aircraft Company, of Torrance, California, began flight tests a few months ago. The accompanying series of pictures shows one of the first attempts at transition over the USAF Flight Test Center at Edwards Air Force Base, when the aircraft, after a vertical take-off and climb, changed to level flight at a height of more than 3,000 ft. by altering the angle of the ducted rotors. The Model 16 is powered by an 850 h.p. Lycoming T53 gas turbine in the centre of the fuselage. In addition to the aerodynamic control surfaces there is at the fuselage rear a special deflection system for the exhaust gases from the T63 turbine.*



For Whom the Bell Tolls...

Anxiety in the Services and Industry

Once again the eyes of the three American services and firms in the aircraft, missile and fuel industries are turned towards the Pentagon's Budget Division, which can shower them with funds... or cold water.

This time the concern is not so much over the total amount of the defence budget—though many voices have clamoured for either its reduction or increase—but the distribution of resources within the limits fixed. The sum of $41,000 million dollars allocated for U.S. defence in fiscal 1960 is still quite imposing, especially when it is remembered that annual credits after World War II, which amounted to $88,600 million in 1944, had dwindled to $11,400 million in 1947, and, after the Korean War, from $ 49,300 million in 1953 to $ 39,100 million in 1955.

Anyone would think that quite a lot could be done with $41,000 million, but of course it is the same old story: each of the defence branches and industrial sectors is firmly convinced that the demands of both justice and strategy entitle it to the lion's share of the budget allocations, and each is vociferously asserting its claim.

This is not merely a new outbreak of inter-service rivalry. Not only are the Air Force, the Navy and the Army fighting for recognition of their various projects, but the defence sectors of each of the three departments overlap, and the strife is between the advocates of the manned aircraft and those of the long-range missile, between the partisans of chemical fuels and those of atomic fuels. To make the confusion even worse, the civil space research and development authorities are also joining in the dollar debate.

When President Eisenhower laid his budget proposals for fiscal 1960 before Congress on January 19th this year, his watchword for the $40,900 million defence budget was: The USA must *create and maintain* a flexible defence force ready to go into action *in a conflict of any kind*...

At the end of August, however, when the Pentagon's finance planners axed Air Force and Navy development and procurement programmes, the blow fell almost entirely on manned aircraft, their engines and equipment... and on a fuel in which not only its producers but also airframe and engine manufacturers had placed high hopes.

Fallers by the wayside

In brief, the projects abandoned are as follows:

• *The SeaMaster large flying boat, developed by the Martin Company.* It came as something of a surprise when, at the end of August, the U.S. Navy announced from Washington that, "as a result of unforeseen technical difficulties", it had decided to cancel the Martin P6M four-jet *SeaMaster* programme. Could the "unforeseen technical difficulties" be sitting in certain seats in the Budget Division of the Pentagon?

The chief sufferer is the U.S. Navy, which during the past seven years has invested about $400 million in the *SeaMaster* programme, out of which $387 million went to Martin, $11.5 million was allotted for the construction of test and development installations, and $1.4 million floated away on a floating service dock. It has been estimated that the cancellation of the project will save $72 million. Although outside observers should refrain from expressing opinions on the husbandry of the USA's financial resources, it must nonetheless be remarked that a private undertaking would not feel very happy at having sunk $400 million into a project which had to be abandoned to save a mere $72 million.

As for the Martin Company, its President, George M. Bunker, has stated that the cancellation of the project will have little effect on the firm's activities. The profit envisaged for 1959 is not expected to drop by more than 4 percent as a result. (Nevertheless, Martin has had to dismiss more than 2000 employers).

• When submitting its procurement plans for fiscal 1960 the USAF had placed particularly high hopes in the *North American Aviation F-108 Rapier two-seat long-range supersonic interceptor*, and in February 1959 demanded "top priority" for its production. It has now been decided to drop the F-108 as a self-contained weapons system and use it in limited numbers purely as a test vehicle for parts of the B-70 supersonic bomber.

Both fighter and bomber were originally part of a coordinated USAF plan of some interest. Initially designed as guided weapons platforms, both models were to be operated within the mixed force concept (a combination of manned aircraft and guided missiles), in which the entire mission (cruising, target approach, delivery of weapon and return flight) was to be carried out at maximum speed. The F-108, which was to be flight-tested early in 1960, would thus have flown to attack targets 1,000 miles away, fulfilled its mission and returned to base, all at a speed of Mach 3.

By comparison with this ambitious programme, the present application of the supersonic fighter amounts virtually to its abandonment.

• The third victim is the *General Electric J93-5* engine (the exotic fuel variant of the J93 straight jet) projected as ultimate powerplant for the North American B-70 *Valkyrie* bomber. According to a General Electric release of mid-June, 1959, the USAF had allocated $100 million for the development of this "highly secret" supersonic powerplant. On August 11th, however, the USAF announced that work on it would be stopped (though development of the conventional fuel J93-3 version for the B-70 will continue)...

• and that *contracts for the production of the new high energy boron fuels by the Olin Mathieson Chemical Corporation would be cancelled.* The USAF had already spent some $100 million on the programme: $45 million for the Olin Mathieson plant, which has been under construction at Model City,

Production of the giant Martin *SeaMaster* flying boat has been cancelled, after the U.S. Navy had invested some $ 400 million in the project.

near Niagara Falls, for three years, and $55 million for the development of the fuels themselves.

On August 12th the U.S. Navy followed the Air Force's lead and dropped its plans for producing exotic fuels, on the grounds that the improvements in jet engines using conventional fuels had made it no longer worth while to spend time and money on converting them to utilize exotic fuels. According to the Pentagon the boron fuel programme had cost the USAF and the U.S. Navy about $232 million.

Cut back or threatened

• At the end of August the USAF notified the *Convair Division of General Dynamics Corporation* that the number of *Convair B-58 Hustler supersonic bombers* to be built in fiscal 1960 (July 1st, 1959 to June 30th, 1960) was to be cut from 40 to 32. In this way the USAF hopes to save about $200 million.

• The ultimate fate of the *North American B-70 Valkyrie intercontinental bomber,* which was expected to fly in about three years, will depend on the success of the ICBM. Certain circles in Washington regard the B-70 merely as a kind of "stop-gap" to fall back on if the ICBMs do not fulfil the promise which they at present show. If they prove themselves in operation, the days of the manned bomber may be numbered.

• Another open question is the fate of the *J58 jet engine (30,000 lb thrust class),* developed by *the Pratt & Whitney Division of United Aircraft Corporation* under contract to the U.S. Navy. So far the Navy has not yet begun development of an airframe suitable for this engine. And since the conversion of existing aircraft types to guided missile carriers has proved successful, it is most uncertain whether the Navy will ever decide to build carrier-borne aircaft using the J58 engine.

•

On the other hand, however, rumours to the effect that the USAF is considering slowing down the *Boeing B-52H bomber* programme, appear to be without foundation. According to a Boeing Airplane Company release of September 4th, the USAF has given the firm the green light for this project, and the first prototype is due for completion early in 1961.

Sitting Pretty

The triumphal progress of the missile continues almost unchecked. In the opinion of the American magazine *Newsweek* the position of certain of these weapons in the equipment programme is "almost as solid as an infantryman in a foxhole". First to be mentioned is the Convair *Atlas* ICBM. But "an assured future" is also forecast for the Martin Co.'s *Titan,* already test-flown, and the Air Research and Development Command's *Minuteman.* This also applies to a whole series of others, such as the Lockheed *Polaris* and *Hound Dog,* the Martin *Pershing,* the Sperry-Rand *Sergeant,* the Goodyear *Subroc* and the Bendix *Eagle* etc.

The U.S. Army has also some reason to be satisfied with the success of its *Nike-Zeus* project, although a further postponement of the decision to start production is quite likely in view of the relatively early stage of development of this weapon, its high cost and its inability to distinguish between enemy decoys and live missiles.

Other cuts are also to be expected in the Continental Air Defense Programme: fewer *Nike Hercules* bases, no further extension of the SAGE system, which will probably remain limited to the highly industrialized regions of the USA.

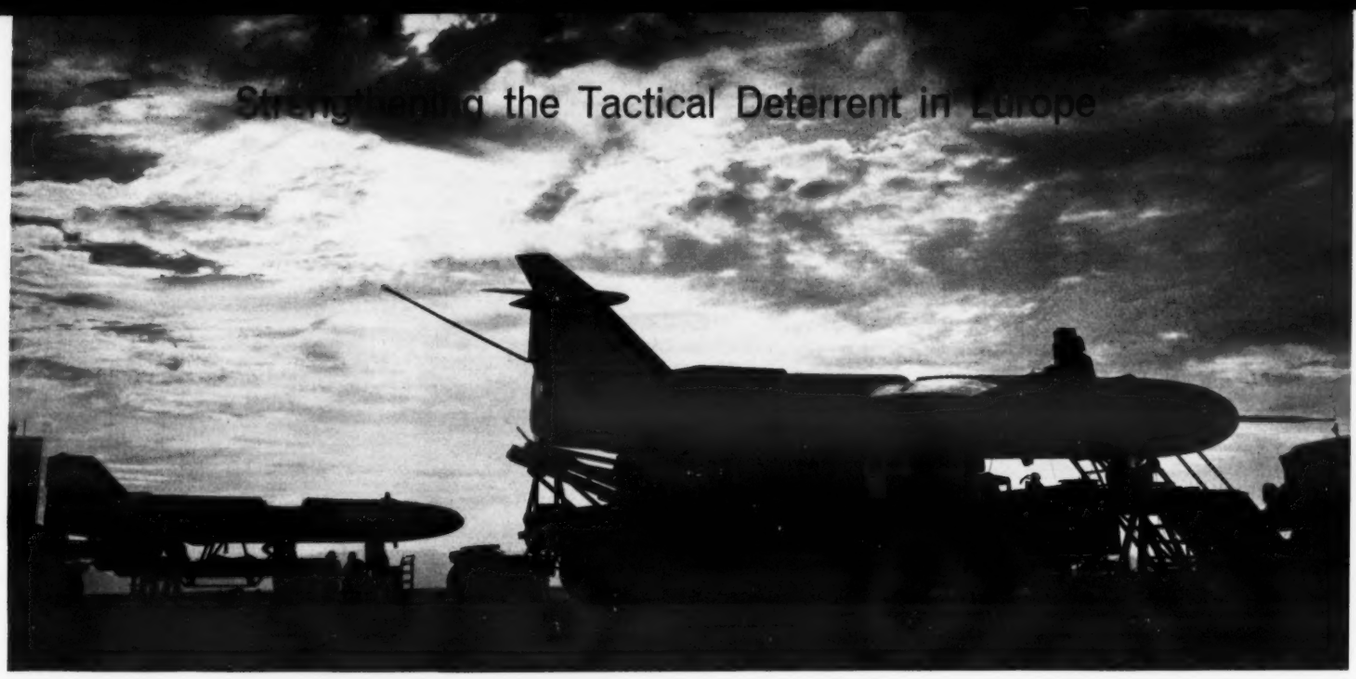
On the whole, American defence planners make no secret of the fact that they prefer pilotless missiles to manned aircraft... for the time being, at any rate. It almost seems as though the Pentagon were being converted to the "pure guided weapon concept" of the 1957 British White Paper on Defence. Whether or not this drastic turn in the direction of the guided weapon will be lasting, remains to be seen, but in the immediate future the industry must get used to the idea of a large number of "research and development programmes", working cautiously towards new weapons systems which will take some time to reach maturity in the shape of profitable quantity orders. Or, as William M. Allen, President of Boeing Airplane Co., said in a report to the company's shareholders: "We must anticipate a market in which volume production of a single product will be the exception and rapid technological advance will be the rule."

The old-established firms in the industry, resting as they do on a sound basis, will be able to ride out the storm. The fate of the host of smaller firms will depend mainly on the adaptability of their commercial organization and on economic development in general... For whom the bell tolls.

By cutting down the number of Convair B-58 *Hustler* supersonic bombers to be delivered during fiscal 1960 from 40 to 32, the USAF hopes to save $ 200 million.

The chances that the North American B-70 *Valkyrie* intercontinental bomber will come into service alongside the ICBMs appear to be fifty-fifty.

This question mark appears to be out of date in the light of the latest reports. At any rate Boeing announces that the USAF has given the green light and released $100 million for the latest, "H", version of the Boeing B-52 bomber.



American Mace Missiles Take up Positions on the Rhine

NATO's forward defence belt in Central Europe has recently acquired new backing. For some months past the USAF's base at Sembach, West Germany, has been equipped with Martin TM-76A *Mace* tactical missiles, which can operate at altitudes from near-ground level up to 40,000 feet, have a range of over 650 miles and in the event of war would carry atomic warheads. The *Mace* speeds unerringly on its pre-determined trajectory and penetrates the target area at transonic speed, without betraying its presence by guidance signals from a ground station.

The first of three USAF missile units to be equipped with the new Martin weapon is the 587th Tactical Missile Group of the 38th Tactical Missile Wing. Two more Groups will shortly be receiving the faster, longer-range *Mace* as a replacement for the older TM-61 *Matador* weapons system. Delivery to USAF units in Germany is taking place under a modernization programme applied to the U.S. Air Force in Europe and, five years after the first American missiles were stationed on German territory, provides new tactical reprisal weapons of high precision and reliability to meet the long-expressed requirement for a strengthening of NATO defences. The TM-76A has an automatic map-matching guidance system developed by Goodyear Aircraft Corporation. This periodically compares the radar picture of the terrain over which the missile flies with a film strip of the programmed route. The "guidance" film is prepared in advance from topographical maps and can show any desired course, on which the missile can be made to dodge mountains or heavily fortified areas, varying altitude as required. As the ATRAN guidance system (ATRAN = Automatic Terrain Recognition and Navigation) works without radio command signals from a ground station and makes only occasional radar transmissions to check the missile's course, there is no danger of the system's being jammed by enemy electronic countermeasures.

With its mobile launching ramp, *Mace* can be employed in any kind of terrain. Field operation and assembly have been greatly simplified compared with the predecessor weapons system, and a ground crew of less than ten men can handle and launch "several" missiles. The Allison J33-A-41 jet engine (5,200 lb thrust) used to provide sustained power, runs on standard kerosene, which is available at all air bases and in most field supply depots. For rapid launching purposes the missile carries under its fuselage rear a solid-propellant rocket booster built by Thiokol Chemical Corporation. The sustainer engine is started while the missile is still on the launcher, but a retainer bolt holds the weapon back until the booster is ignited. Thereupon the latter's 100,000 lb of thrust accelerate the missile to cruising speed within seconds.

For operation from unprepared positions, use is made of a Goodyear combined transport and launching vehicle, with adjustable balloon-type tyres, known as a "Translauncher". This trailer-type vehicle can be towed across the most difficult

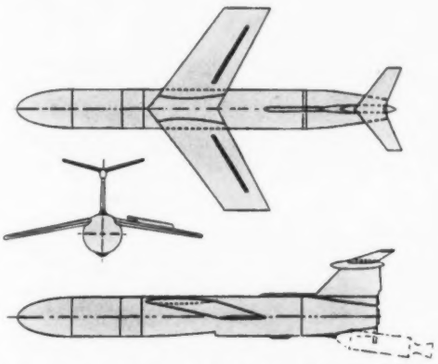
A *Mace* convoy on the move: the front vehicle tows a dismantled TM-76A on a trailer, the rear vehicle (without trailer) carries containers of ground support equipment on its loading platform.

Left: This TM-76A launcher has been driven into firing position and set down on its supports. Final check-out is about to begin, with the aid of the field test equipment installed on the trailer. Later the towing vehicles and trailers will move aside, the missile cradle will be erected (see also right-hand picture in centre row), the rocket booster attached and the jet engine started. The *Mace* will then be ready for launching. — *Right:* The missile leaves its launcher amid roaring flames.

terrain by an eight-wheel "Teracruzer" designed by Four Wheel Drive Auto Company. The "Teracruzer" also carries the operating crew, test equipment and other ground support equipment. It has the same type of balloon tyres as the trailer, and the pressure of all twelve tyres can be varied en route to suit terrain conditions. The *Mace* unit can travel at speeds of up to 40 m.p.h. on good roads, or cross sandy or swampy ground at lower speeds. Other "Teracruzer" vehicles carry weather-proof equipment containers housing all the instruments required for preparing the launching, checking out the missile and the actual launching. Finally, yet another "Teracruzer" carries a universal crane capable of lifting any of the equipment or missile parts.

Although the *Matadors* stationed in West Germany are initially being replaced by the TM-76A version of the *Mace,* a new version, the TM-76B, is already in preparation. In this model the ATRAN system will be replaced by an inertial guidance system developed by the AC Spark Plug Division of General Motors. This works on a "memory" principle and continuously computes the missile's position in relation to the point of launch and the target. As with the ATRAN equipment, any desired course can be followed. The TM-76B can be used for either high or low level attacks and has a range of 1,200 nautical miles at altitude.

Another striking feature of the *Mace* weapons system, in addition to its exceptional mobility, is its low unit cost. Including the Government-supplied engine, the rocket booster and the ATRAN guidance equipment, the TM-76A is reported to cost only around $250,000 in large-scale production. As, in addition, ground control stations can be dispensed with, the *Mace* is simpler and cheaper to operate than its predecessor, the *Matador.* Finally, Martin's Baltimore Division has prepared a training version which contains a recovery parachute system in the forward fuselage instead of the warhead and can be fired repeatedly for practice purposes.



Three-view drawing of the Martin TM-76A. Overall length 44 ft., span 22.9 ft., fuselage diameter 54 in.

The *Mace* on its erected cradle, ready for launching.

The TM-76A *Mace* tactical missile in production at Martin's Baltimore plant. In the foreground, nose, fuselage centre section and tail are being mated; in the rear work is in progress on the fuselage centre sections.

Aer. Macchi MB. 326

The successful Franco-British method for the training of military pilots—the abandonment of piston-engine aircraft for all-through training on jets—has recently been adopted by the Italian Air Force and has resulted in new specifications for jet-powered trainers. To meet these requirements *Aeronautica Macchi S.p.A.*, of Varese, has developed the MB. 326 trainer, powered by a Bristol Siddeley *Viper 11* jet engine. The aircraft, which has excellent flying qualities and is easy to maintain, has two fundamental characteristics:

- Moderate wing loading and stalling speed to simplify the training of beginners;
- High speed straight and level, good rate of climb and rapid descent owing to the high Mach number permitted in the dive give pilots an early opportunity of familiarizing themselves with the performance of modern combat aircraft.

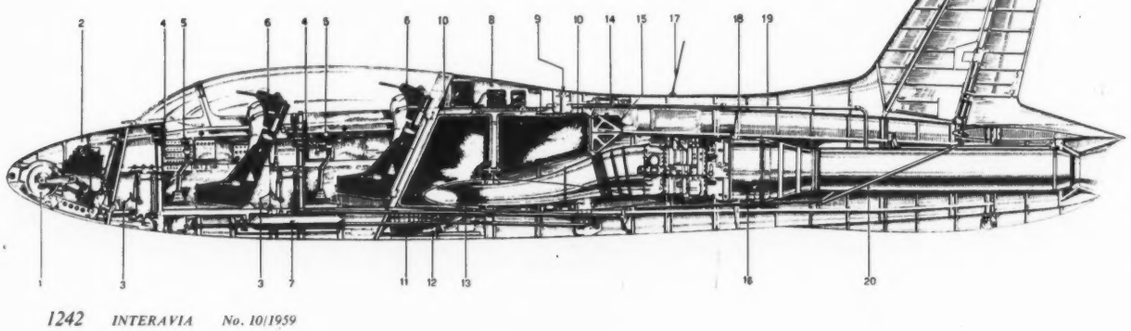
The MB. 326 is an all-metal low-wing aircraft with tandem seating. Its *fuselage* is in three sections: the nose, accommodating the nosewheel and radio equipment; the tail, which houses the jet pipe and carries the tail unit; and the centre section, which contains the two Martin-Baker ejection seats for instructor and student, two flexible tanks carrying the main fuel supply (205 U.S. gall.) and the jet engine with its air intakes.

A one-piece cockpit canopy covers both seats and opens to the right. It is exceptionally wide, so that the rear pilot has a clear forward view over the shoulder of the one in front, simply by moving his head to one side. This is a great advantage, particularly when coming in to land at high incidence. He thus has better visibility at all attitudes than if the rear seat were on a higher level and the cockpit narrower (in the case of the MB. 326 the difference in levels is only two inches, in other tandem-seat trainers it may be up to ten inches). The canopy jettisoning mechanism is synchronized with the ejection seats. Air for cockpit pressurization is bled from the jet engine compressor

Dimensions, Weights, Performance

(with Bristol Siddeley Viper 11)

Wing span		32′ 9″
Length		35′
Height		11′ 7″
Wing area		204.52 sq.ft.
Aspect ratio		5.27
Weight equipped		5,027 lb.
Crew	375 lb.	
285 U.S. gall. fuel (wing-tip tanks full)	1,907 lb.	
Radio and other equipment	121 lb.	
Useful load		2,403 lb.
Take-off weight		7,430 lb.
Static thrust sea level		2,500 lb.
Max. wing loading		36.3 lb./sq.ft.
Thrust loading		3 lb./lb.
Static thrust per sq. ft. wing area		121 lb.
Maximum true airspeed		
at 20,000 ft.		440 kn
at 40,000 ft.		430 kn
Clean stalling speed		85 kn
All down stalling speed		74 kn
Take-off run at a weight of 7,430 lb.		1,480 ft.
Take-off distance (to clear 50-foot screen)		1,970 ft.
Landing distance (over a 50-foot screen)		2,130 ft.
Sea level rate of climb		4,420 f.p.m.
Time to 10,000 ft.		2 min 36 sec
20,000 ft.		5 min 48 sec
30,000 ft.		10 min 30 sec
40,000 ft.		18 min 30 sec
Service ceiling		40,000 ft.
Range at 30,000 ft. at 302 kn cruising speed, full fuel supply less 32 U.S. gall. reserve		600 n.m.
Endurance		2 hr 7 min
Max. speed indicated		440 kn
Max. dive Mach number		0.82
Critical Mach number		0.76
Max. rate of roll		130°/sec
Max. pull-out acceleration		8 g



1 Nosewheel
2 Standby VHF equipment and Marconi AD.722 ADF
3 Adjustable rudder pedals
4 Instrument panel
5 Control column
6 Ejection seat (Martin-Baker Mk.4)
7 Oxygen bottles (six)
8 Saram VHF equipment
9 Fuel filler
10 Main fuel tank
11 Turbo-refrigerator unit for air conditioning plant
12 Dive brake
13 Engine air intake
14 Relief and vent valve
15 Batteries
16 Viper 11 engine
17 VHF antenna
18 Fire bulkhead
19 Fuel vent pipe
20 Rudder controls

and is brought to the desired pressure and temperature in a turborefrigerator unit.

The *slightly swept and tapered wing* is in two sections; it is directly attached to the fuselage and has a type NACA 6A airfoil, the thickness/chord ratio being 13 percent at the roots and 12 percent at the tips. Its main spars carry the main undercarriage members which retract outwards into the wings: the ailerons and Fowler flaps are hinged on the secondary spars. A streamlined auxiliary fuel tank with a capacity of 40 U.S. gallons is fitted at each wingtip. The elliptical air intakes are embedded in the wing roots, but far enough in front of the leading edge and from the fuselage skin to avoid boundary layer interference with the air stream. Finally, a boundary layer fence is mounted in line with the division between ailerons and landing flaps.

When planning the *tail unit* the designers took great care to avoid all screening effects so as to ensure full spin capacity. All control surfaces are mechanically actuated; elevators and ailerons are fitted with trim tabs. The Fowler flaps and the dive brake in the belly of the fuselage are, on the other hand, hydraulically controlled.

The *undercarriage* is exceptionally robust and has been tested for a drop speed of 710 ft/min. Even at a drop speed of 830 ft/min no permanent deformations were noted. All three wheels are hydraulically retractable.

The *Viper 11 axial compressor jet engine* delivers a maximum thrust of 2,500 lb (at 13,800 r.p.m.) and a cruise thrust of 2,160 lb (at 95 percent of the maximum r.p.m.), at sea level and at standard temperature. The specific fuel consumption during cruise is about 1.09 lb/lb/hr. A central pressure refuelling system (lower fuselage, right) is provided for all four tanks; refuelling with 285 U.S. gallons is completed in five minutes. Fuel is transferred from the wing-tip tanks to the main tanks by a compressed air system.

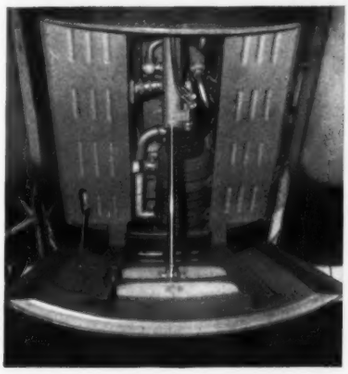
Systems: The undercarriage, wheel brakes, landing flaps and dive brake are all operated hydraulically. The electrical system is supplied from a 6,000 W generator and two accumulators, and is equipped with two 190 VA alternators for the A.C. instruments. Oxygen supply is enough for 3½ hours, so that it is not necessary to refill after each training flight. Finally, brief mention must be made of the aircraft's instrumentation and radio equipment, which ensure unlimited blind flying capacity: a Gyrosyn J2 electrical gyro-compass and electrical gyroscopic horizon with identical indicators for both pilots; Saram 2ARC 12-channel VHF equipment, Aviokit 6-channel standby set and Marconi AD.722 ADF for use at both positions. The accompanying pictures show how easily accessible all this equipment is for maintenance purposes.

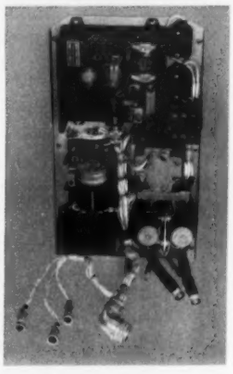
*

Since the maiden flight of the first of the two prototypes on December 10th, 1957, the MB.326 has undergone numerous flight tests totalling several hundred hours, which have fully confirmed the results of calculations and the lengthy wind-tunnel tests. Proof was furnished in particular of the aircraft's unlimited aerobatic capacity—its rupture load factors are +12 and —6 at indicated speeds of 440 knots (IAS) or Mach 0.82. At the critical Mach number (0.76) a slight buffeting of the wing occurs, though complete control is maintained even after further acceleration; the deceleration due to the use of the dive brake is about 0.5 g. The aircraft behaves well at the stall, which is prefaced by a slight shaking of the control column. The excellent take-off and flying qualities of the MB.326 can be seen from the accompanying data.

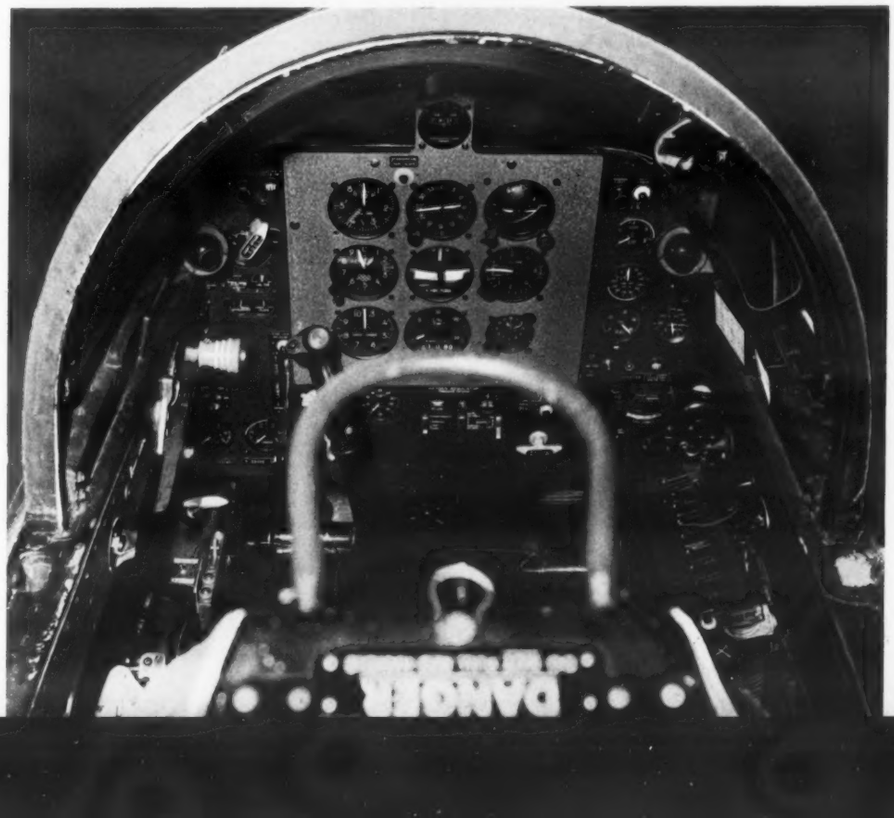
A pre-production batch of twenty MB.326 aircraft is already being built at Aeronautica Macchi, and the first production model will be delivered to the Italian Air Force in spring 1960. Thenceforward the delivery rate will be gradually increased to six per month. In this connection it is interesting to note that negotiations for sales to several foreign governments are also in hand.

For ease of maintenance the internal components and equipments are accessible through at least three dozen doors and inspection ports and several dozen more quick-release panels. The lower pictures show some details: Easy maintainability of the turbo-refrigerator air-conditioning unit when air brake is extended (left); accessibility of the hydraulic system (centre) and engine starter with voltage regulator (right), both covered by the same panel.

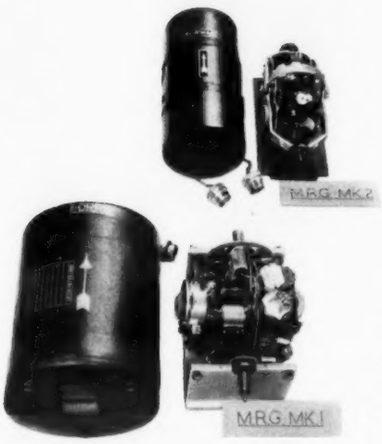




View of the front pilot's seat. The centre section of the instrument panel contains: Magnetic compass (centre top); airspeed indicator, gyro-compass indicator, gyro horizon (upper row, left to right); altimeter, turn and slip indicator and rate of climb indicator (centre row); machmeter, fuel flowmeter (with residual fuel indicator) and chronometer (bottom row). The VHF channel selector switch (not visible in picture) is on the left, behind the throttle, the ADF control unit is to the right, below the engine instruments. The right-hand coaming contains the electrical switches, and the large handle on the left of the control column is the canopy lock.

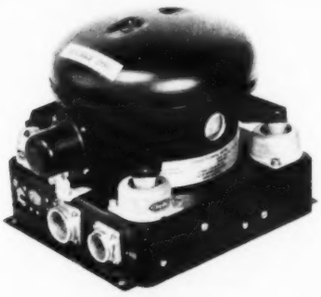


Telecommunications and Electronics at Farnborough

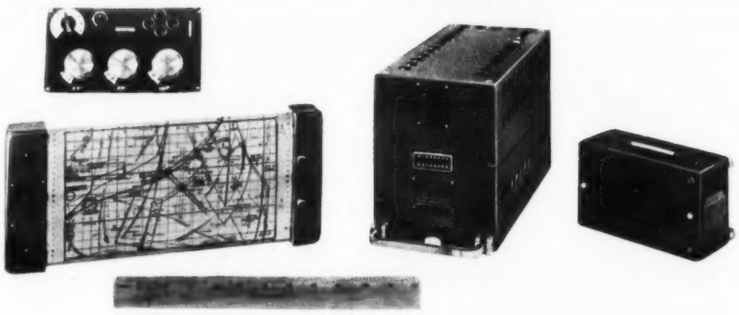


● The Mk 1 and 2 Master Reference Gyros now in production by **S. G. Brown Ltd.** The Mk 1 unit is fitted as standard equipment in all the latest RAF and RN fighters. The Mk 2 is a developed version of smaller size and weight and greater accuracy than its predecessor.

● The **Marconi Wireless Telegraph Co.** exhibited a scale model of this Type S.247 high power (S and L band) "back-to-back" long range surveillance radar. Output is 2½–3 megawatts on each frequency and the radar can give continuous cover on a target up to a height of 75,000 ft. with a range of approximately 250 miles.



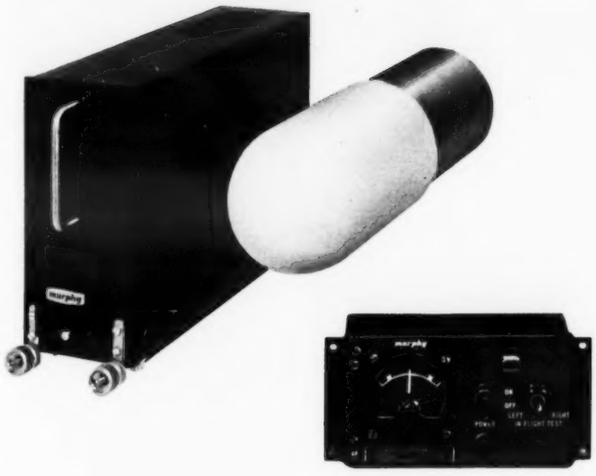
● The **Sperry Gyroscope Co.** "Rotorace" directional gyro incorporates a new bearing technique in which counter-rotations are applied to the gyro sensitive axis bearings. This averages out the disturbing functional torques which these bearings apply to the gyro and has enabled a tenfold increase in the accuracy of conventional gyros to be achieved.



● The individual units of the lightweight Mk IX version of the **Decca Navigator.** The complete installation weighs less than 30lb. and has been developed for use in light aircraft or for Service use in fighter aircraft.

● **Pye Telecommunications Ltd.** exhibited a comprehensive range of communications equipment including this transistorized VHF radio-telephone mounted on a Vespa scooter.

● Most recently announced product of **Ekco Electronics Ltd.** is a transistorized airborne weather radar weighing 56 lb. The 15 kW "X" band transmitter-receiver, combined indicator/control unit and 24 inch scanner are illustrated below.

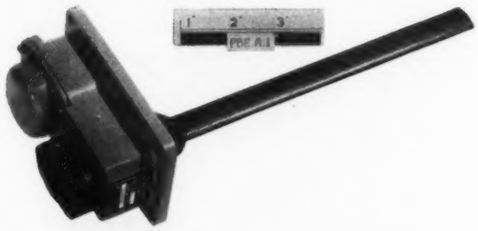


● The receiver, aerial and control unit of the Leader Cable landing system developed by **Murphy Radio Ltd.** A commercial version known as **Autoland** has been produced in conjunction with Smiths Aviation Division and Standard Telephones and Cables Ltd.

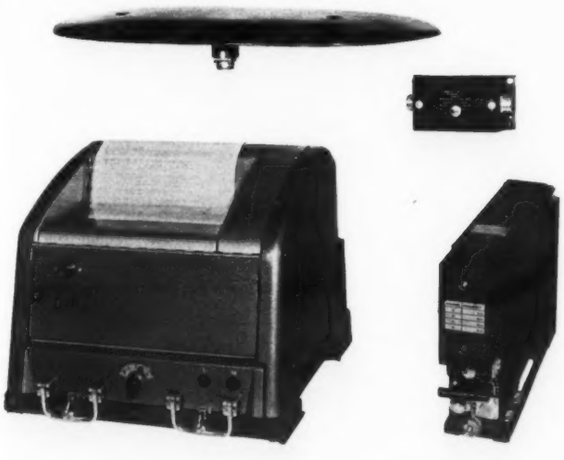
● The cockpit installation of the **Marconi** Type AD722 subminiature automatic direction finder in a **Super Aero 45.** The relative bearing indicator is mounted at the lower right hand side of the control unit.

● An ultrasonic flaw detector exhibited by **Solus-Schall Ltd.** Ultrasonic waves produced by piezoelectric effects are transmitted into the specimen and are reflected by the flaw. Peaks on the fluorescent screen indicate the transmission pulse, the flaw echo, and the backwall echo. The instrument can also be used to measure wall thicknesses where only a unilateral approach is possible.

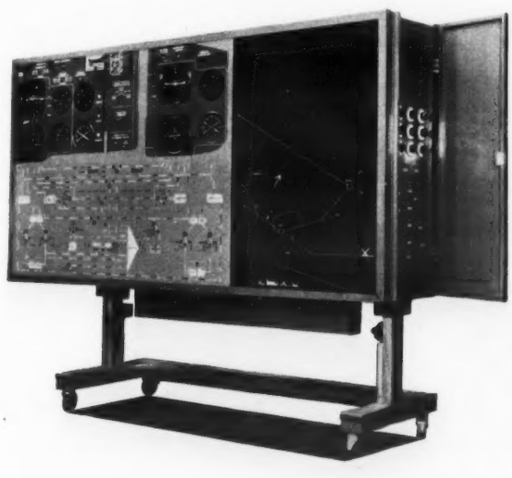
● The visual icing indicator produced by **Teddington Aircraft Controls Ltd.** Consisting of a metal rod of high catch section projecting into the airstream within the pilots view, it ices up more readily than the aircraft surface. The rod may be deiced periodically by means of an internal heater to determine whether icing conditions still exist.



● The **Marconi** Type AD.308 transistorized airborne teleprinter receiver was designed to relieve congestion of the HF communication channels by receiving routine messages (weather reports etc.) in the low frequency band, 90–150 kc/s. The aerial and matching unit are illustrated above the teleprinter and receiver unit.



● A classroom training aid developed by **Air Trainers Link Ltd.** in conjunction with British Overseas Airways Corporation. The model illustrated here provides a fully animated reproduction of the Bendix Flight System as fitted to the Boeing 707.



The Canadair-Convair 540 Tours Europe

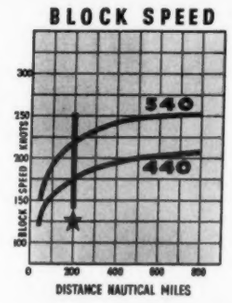
Before setting out on its tour of Europe the Canadair-Convair 540 took part in the flying display at the 23rd Paris Air Show.

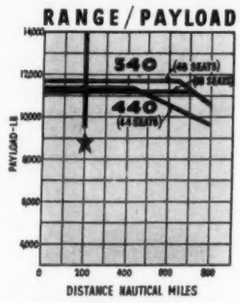
During the Spring of this year two prototypes of the Canadair-Convair 540 turboprop transport made an extensive demonstration tour throughout North and South America, visiting some 60 cities between Vancouver and Montevideo. Then in May another prototype, amply provided with auxiliary fuel for crossing the Atlantic, set off from Montreal on a similar programme in Europe. The aircraft first took part in the flying display at the 23rd Paris Air Show (June 12th to 21st) at Le Bourget, then spent a week in Britain and took off again from Blackbushe on June 28th. On the ensuing trip it visited another nine European countries: Sweden, Finland, Norway, Switzerland, Spain, Portugal, Germany, Austria and Belgium.

On its "tour d'Europe" and the many intervening demonstration flights for representatives of the airlines and the press, the crew was accompanied by sales teams from the airframe and engine manufacturers, namely *Canadair Limited, Montreal*, a subsidiary of General Dynamics Corporation, and *D. Napier & Son Ltd., London*, a member of the English Electric Aviation Group.

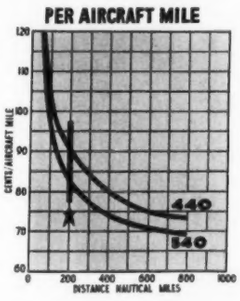
These sales teams announced that Canadair is at present building an initial batch of ten 540 military transports for the Royal Canadian Air Force. The first of these are already flying, and negotiations are in hand for civil or military follow-on contracts. In addition, a number of Convair-Liner CV-340s and CV-440 *Metropolitans* have been converted into the 540 turboprop model. The latter include the version demonstrated in Europe. As the two Napier *Eland NEI.6* propeller turbines in the 540 model each deliver 3,500 e.h.p. on take-off, or roughly 40 percent more power than the two-row radial R-2800s in the CV-340 and CV-440, seating capacity in the standard class layout of the 540 has been increased by four seats (to 48) and in the economy class layout by as many as 14 seats (to 58). Nevertheless, even at the new gross weight of 53,200 lb, the take-off distance of the turboprop aircraft is roughly 10 percent shorter than that of a fully-loaded *Metropolitan*, and initial climb speed is nearly twice as high. The improvements in block speed, payload/range characteristics and direct operating costs are shown in the accompanying diagrams.

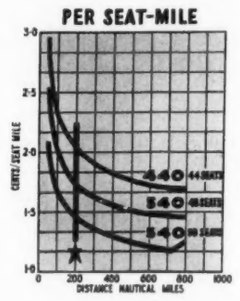
Thanks to the demonstration tour, countless air transport experts have had an opportunity of experiencing for themselves the 540's high take-off acceleration, good climb performance and smooth, vibrationless cruise. Meanwhile the demonstration aircraft has returned to Montreal, and both Canadair and Napier are continuing their production and conversion programme on what must be described as the fastest medium-stage airliner in its class.





On the typical short stage of 200 nautical miles (marked by an asterisk) block speed of the 540 model is 25 percent higher than that of the CV-440 **Metropolitan.** Payload remains roughly similar, but maximum block distance (range) with full load is roughly 50 percent higher. A similar improvement between the CV-440 and the 540 on a 200-nautical-mile stage is also to be seen in direct operating costs. These fall from 89.6 cents per aircraft-mile to 82.7 cents, and from 2.04 cents per seat mile to 1.72 cents for the 48-seat layout and to 1.43 cents for the 58-seat model.





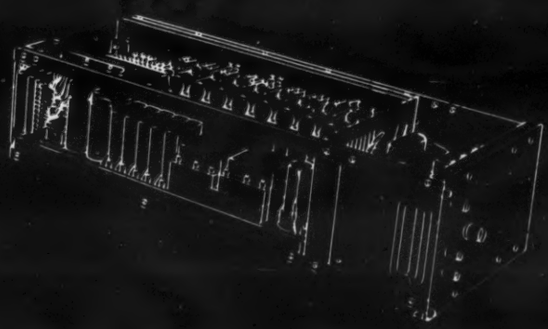
Norwegian visitor in national costume at Oslo-Fornebu Airport.

At Stockholm-Bromma Airport after a demonstration flight for representatives of Scandinavian Airlines System and Sweden's Linjeflyg AB. Passengers included Sven Östling, President of Linjeflyg (second from top), P. B. Paulsen (fourth from top) and Torsten von Horn (dark bow tie and raincoat), both of SAS.

COSSOR

SEC[illegible]Y SUR[illegible]

TRANSPONDERS



In 1684 a Greek adventurer named Paulkon who had become Minister to the King of Siam, the most powerful prince in the Indochinese peninsula, persuaded his master to bid for the friendship of the King of France. Louis XIV, hearing of this ruler, sent as his ambassador the Chevalier de Chaumont. "On our return", writes Choisy, a member of the ambassador's retinue, "people stared at us as if we were performing bears."

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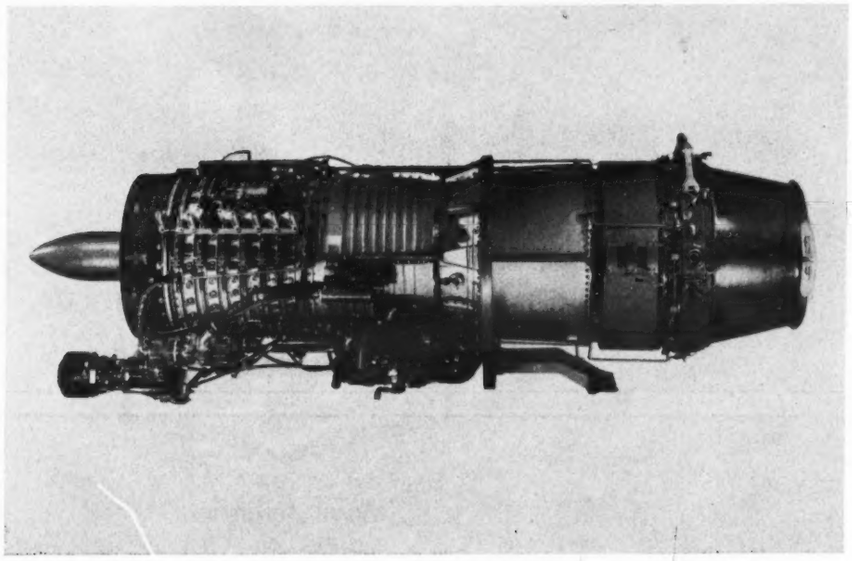
Convair 880 exceeds performance specs

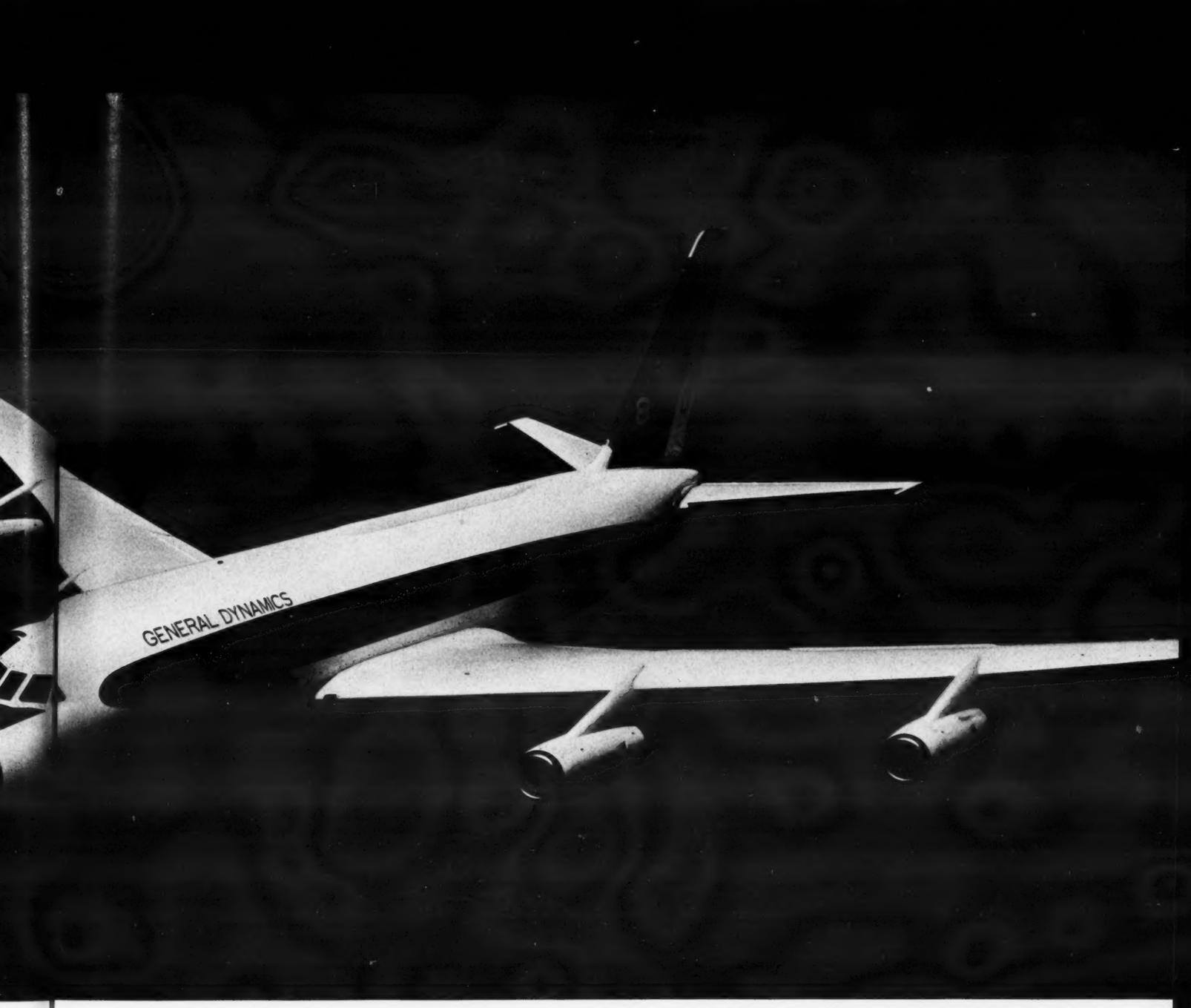
General Electric's CJ-805 jetliner engine shares in an outstanding aviation achievement: in flight tests the CJ-805 powered Convair 880 has not only bettered all performance guarantees, it has met or bettered even drawing board estimates for speed, range and short distances required for take-off and landing. For airlines and their passengers, these flight test results demonstrate how the 880 will go more places and provide the world's fastest, most versatile air transportation. Powered by dependable General Electric CJ-805 turbojets, the Convair 880 will be years ahead for years to come.



TAKE-OFF
less than 5,450 ft.

Flight tests have proved that the 880 can lift off before reaching the 5,450-foot mark * originally estimated. Flight experience indicates that actual runway length needed for take-off may prove to be as much as 5% less. CJ-805 performance has been outstanding throughout Convair's continuing test program. Supporting this record was thorough G-E flight and ground testing which provided information for engine improvements prior to 880 testing. Extensive flight and ground testing continue * *(sea level standard conditions—typical 1,000-mile-trip).*

Outstanding CJ-805-3 performance has helped the Convair 880 exceed performance guarantees for speed, range and short distances required for take-off and landing.



SPEED
615 mph

Four CJ-805 turbojets have provided power for Convair 880 cruise at true air speeds of 615 mph—above guarantee and faster than any other commercial passenger plane in the world. Six months of intensive flight testing have proved speed. 615 mph flights have been powered routinely by CJ-805 engines equipped with reversers and suppressors, demonstrating minimum thrust losses. Engine, thrust reverser and sound suppressor have been produced and tested together by G.E., so their performance is especially well matched.

RANGE
3,450 miles

Engineering estimates of the 880's range and fuel economies have been confirmed by data accumulated during 250 hours aloft on 130 flights. Flown for best economy, the 880 will range 3,450 miles. Excellent CJ-805 SFC's make an especially important contribution. The 880 was designed and built to operate from most present-day airports. Proved range makes the 880 even more versatile by permitting non-stop jet 880 service between metropolitan centers as well as on shorter routes. The 880 can go more places.

LANDING
less than 5,350 ft.

880 landing tests show that the estimated 5,350-foot landing distance may be considerably shortened. In tests, only aircraft brakes were used. Thrust reversers, which provide reverse thrust equal to 48% of forward thrust, can reduce landing distance even further. Short take-off and landing is another reason the 880 can go more places. The CJ-805, which helps make 880 performances outstanding, is the result of knowledge and experience gained in more than 23 million G-E jet flight hours. *General Electric Company, Cincinnati 15, Ohio.*

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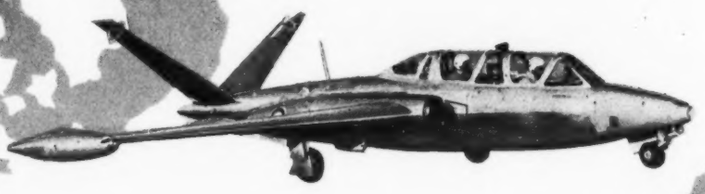
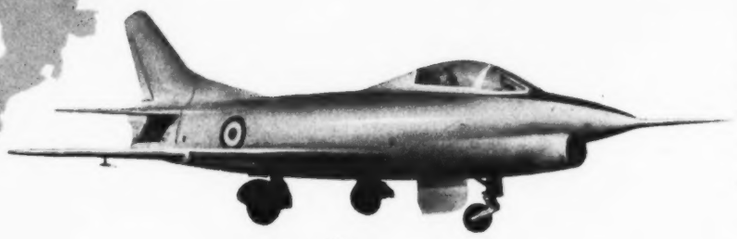
and manufacturers
of aircraft undercarriages
and hydraulic systems





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JOHN S. WASSALL, DIRECTOR OF ENGINEERING, LOCKHEED AIRCRAFT CORPORATION

John S. Wassall, Director of Engineering, Lockheed California Division, is the chief executive of the huge engineering branch which employs 5700 people.

World's speed, altitude and time-to-climb champion, the sleek F-104 Starfighter, is an outstanding achievement in performance and dependability.

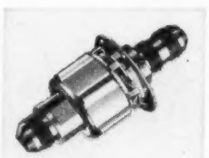
This spectacular new plane scorches the sky in 1500 m.p.h. bursts of speed. It climbs to the very fringe of earth's atmosphere in minutes!

Soundly designed, and utilizing the finest of quality products throughout vital systems, the F-104 is giving many hours of trouble-free service—thanks to Lockheed's devotion to dependability.

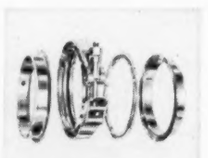
AEROQUIP PRODUCTS ARE USED BY LOCKHEED ON THE F-104

High performance 666 and 677 Hose of Teflon with patented* "*super gem*" Reusable Fittings for the hydraulic system.

Aeroquip 601 Hose Lines with "*little gem*" Reusable Fittings for the fuel system.



Quick-Disconnect, Self-Sealing Couplings for the hydraulic system.



Marman Clamps, Couplings and Joints used in many applications on the F-104.

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"*super gem*" and "*little gem*" are Aeroquip Trademarks. *U.S. Patent No's. 2,833,567 and 2,731,279

DECCA

WEATHER RADAR FOR ZURICH AND GENEVA

To keep a far-sighted weather eye open over 200,000 sq. miles of mountainous territory around Zurich and Geneva—that is the task for which two Decca Type 41 Weather Radars are being installed. A continuous watch for dangerous precipitation areas will be kept by the radar equipments mounted on nearby peaks and information relayed instantaneously to the airports, through direct radar links.

The installation of Decca Type 41 at these two International Swiss airports, is part of a progressive modernisation programme and will provide meteorologists with an outstanding instrument for the preparation of detailed short term forecasts of exceptional accuracy.

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The Small Jet Airliner – the Need and the Answer

By the Project Staff, Hunting Aircraft Ltd., Luton, England

Ever since the introduction into service of the de Havilland *Comet* in 1952, operators throughout the world have been stimulated by the great attraction of the higher speed of jet airliners, and the benefits this offers. More recently the large, longer-range Boeing 707 has made its mark on the transatlantic and transcontinental routes, and in nearly a year's operation has steadily averaged load factors well over 90%, though this may be partly due to the novelty involved.

There are, however, many operators whose route structure and traffic volume are such that large, long-range airliners cannot be contemplated. About 95% of all stage lengths are less than 1,000 nautical miles, and in terms of passenger-miles travelled the percentage is even higher. It is evident that long-range airliners cannot offer the best possible economy on short stages. Larger aircraft mean smaller fleets, which in turn mean less flexibility for ticket scheduling and a larger proportion of the fleet required for overhaul, standby and training. Again, it is fairly safe to say that, with the exception of the more lucrative routes, it is more difficult to obtain high load factors on large aircraft than on smaller aircraft. There are also many routes throughout the world where traffic increases cannot be generated by acquiring larger aircraft, but could be by increasing the frequency of service. On many of the networks there are severe restrictions brought about by airfield length and passenger handling facilities.

The pros and cons of the short-range jet

The following are some of the technical and economic questions which Hunting studied closely before putting forward the present proposal.

Gross weight and airfield length : It is well known that balanced take-off field performance deteriorates with increase in gross weight unless markedly greater penalties are built into the aircraft (e.g. use of uneconomic wing loadings, complex high-lift devices, over-powering etc.) to offset this basic tendency. An indication of the effect of size on take-off field performance is shown in *Fig. 1.*

Powerplant : The advent of the high by-pass and turbo-fan engines strengthens the case for pure jet propulsion over all portions of the range spectrum, as specific fuel consumption reductions up to nearly *one half* that of the earlier generation of pure jet engines have been realized, coupled also with lower specific engine weights in many cases. Such engines include the Bristol Siddeley BE.61 of about 7,000 lb sea level static thrust, the Rolls-Royce RB.163 of about 10,000 lb s.l.s.t. (intended for the DH.121) and the Pratt and Whitney JFT 10A-1 of 8,250 lb s.l.s.t. destined for the new Douglas DC-9 medium-haul jet airliner. This latter engine is virtually a scaled-down version of the P & W JT 3D turbo-fan which can give a thrust of 17,000 lb coupled with a sea level static specific fuel consumption of 0.55 lb/lb/hour. Thus fan engines of a wide range of sizes will be available for jet transports of the future.

The size question : There are no jet airliners in service at present smaller in size than the Sud-Aviation *Caravelle*. This aircraft is of a speed class representing the best that can be done without undue aerodynamic and structural complication, and when equipped with fan engines will be even more attractive. Since, however, the *Caravelle* is a 64 to 80 passenger aeroplane weighing nearly 100,000 lb and designed to be most economic for stage lengths of 1,000 nautical miles or more, a somewhat smaller aeroplane, specifically designed for best economy on stage lengths of 500 to 700 nautical miles, should be able to offer better economy (and airfield performance) for such stage lengths. It would thus appear that the line of development which introduces jet propulsion into airline service can also be applied with great advantage in a somewhat smaller class of aeroplane.

The route structure : It may be taken that the stage distances on which the *Viscount* has operated are essentially satisfactory, not only in terms of the public service provided but also in terms of profitability from the operator's point of view. *Fig. 2* presents the distribution of *Viscount* intensity of operation for different stage lengths, and suggests that a jet aeroplane able to carry full payload for a stage distance of 700 nautical miles will deal with the majority of the traffic offering—the actual percentage of the total is 95.

Profitability : A short-to-medium range jet must of course be at least as economic as the *Viscount* for this argument to be valid. *Fig. 3* compares the profitability of different aeroplanes—taking into account both direct and indirect operating costs and using a load factor of 70% * —in a way which reflects both the initial investment in the equipment and the income from its use. The curves are terminated at the stage distance for half maximum payload. The diagram shows that a jet aircraft of appropriate range performance and payload is indeed much more attractive than the somewhat larger turbo-propeller *Viscount*, even when powered by turbojet engines not giving the marked advantages of the by-pass and fan types. The latter are shown to improve the profitability.

* Using the Society of British Aircraft Constructors' "Standard Method for the Estimation of Direct Operating Costs of Aircraft", Issue 4, but with 2,500 hrs. utilization, IFR fuel reserves, indirect costs $1^1/_2$ d./pass.naut.ml., fare 6d./pass. naut.ml.

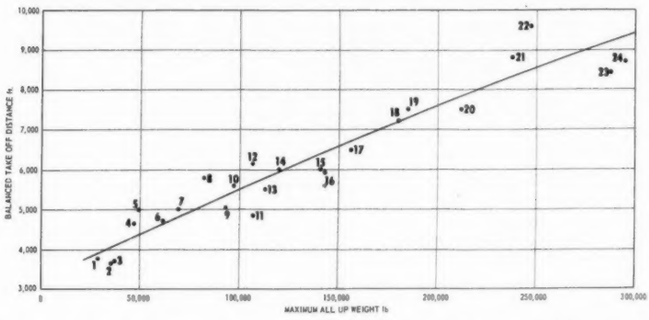


Fig. 1 : Take-off distances (in feet), at standard atmosphere and standard temperature, for 24 passenger aircraft, plotted against gross weight (in pounds). 1. JetStar ; 2. Friendship ; 3. Dart Herald ; 4. Convair 340 ; 5. Convair 440 ; 6. Viscount 790 ; 7. Viscount 840 ; 8. Argonaut ; 9. DC-4 ; 10. Caravelle ; 11. Lockheed L-749A ; 12. Electra ; 13. DC-6A ; 14. DC-9 ; 15. Vanguard ; 16. DC-7C ; 17. Comet 4B ; 18. Britannia 310 ; 19. Convair 880; 20. Boeing 720 ; 21. Convair 600 ; 22. Boeing 707-120 ; 23. DC-8 ; 24. Boeing 707-320.

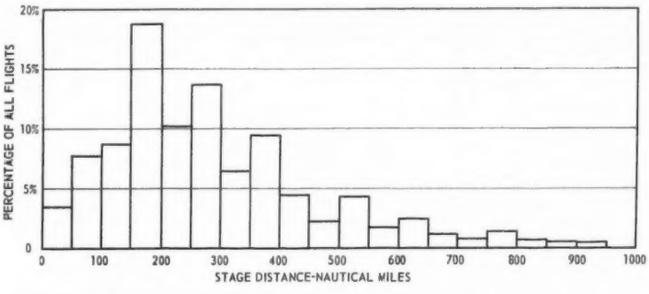
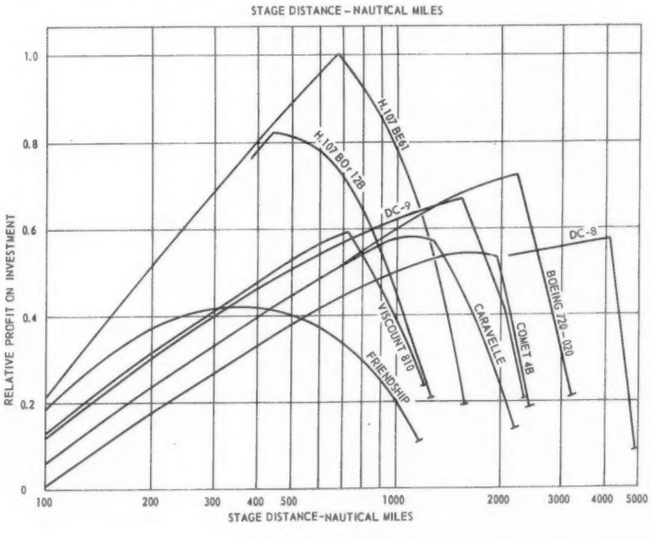


Fig. 2 : Relative frequency (percentage of all flights) of the stage distances (in nautical miles) operated by the Viscount.

Fig. 3 : Relative profit on investment for selected jet and turboprop aircraft, plotted against stage distance (in nautical miles).



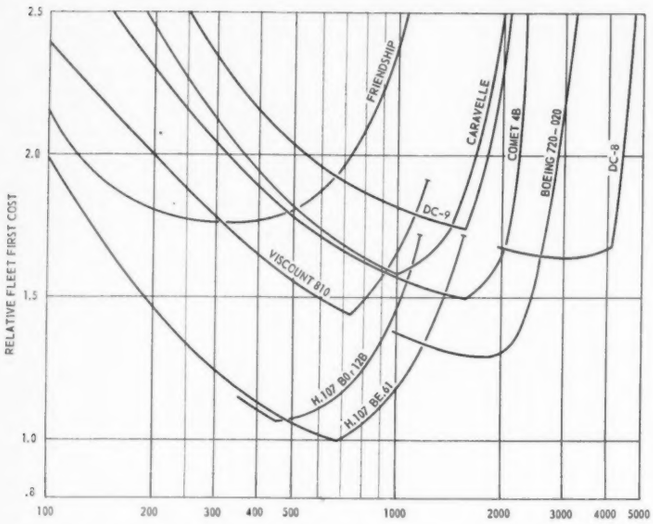


Fig. 4 : Fleet first cost for selected jet and turboprop aircraft, plotted against stage distance (in nautical miles).

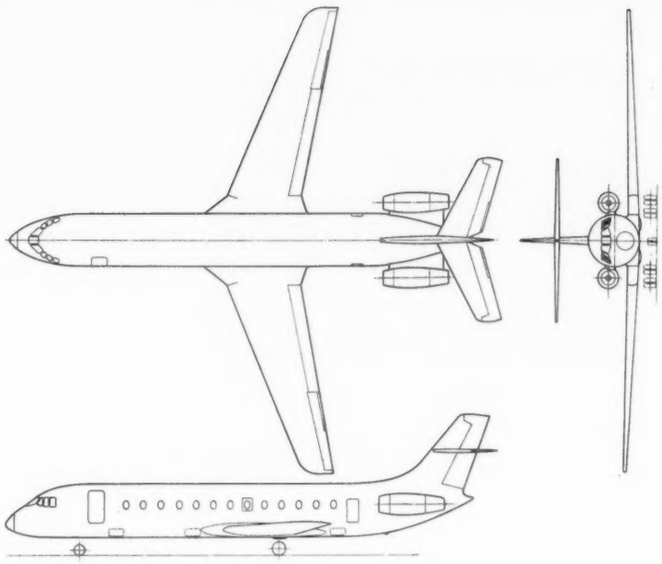
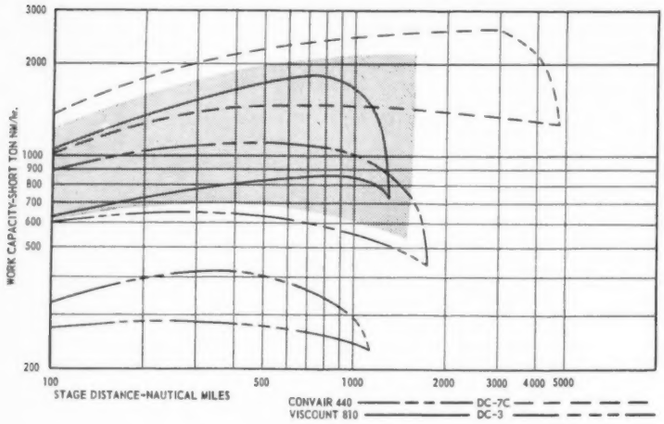
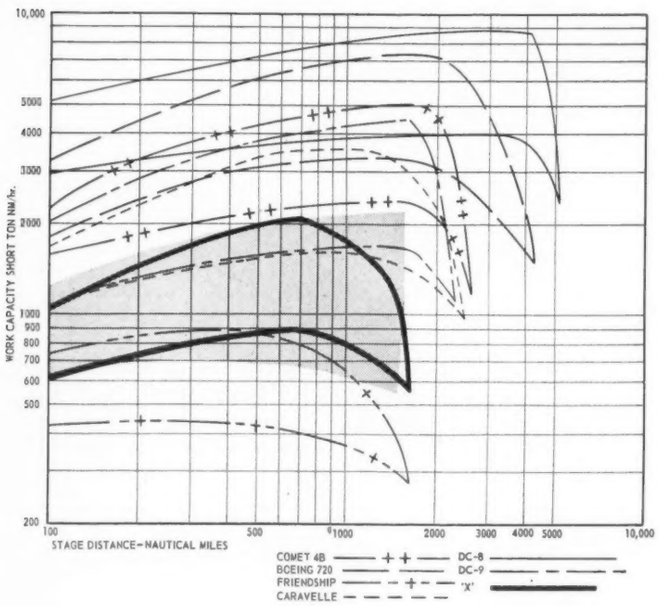


Fig. 7 : Three-view drawing of the Hunting 107.



Figs. 5 and 6 : Hourly work capacity (in short ton-nautical miles) for selected piston-engine and turboprop aircraft (upper diagram) and jet aircraft (lower diagram), plotted against stage distances. The lower limit of each envelope represents the work capacity with break-even payload.



First cost : A further—and very important—aspect of the economics of air transportation is the initial investment required, per se. *Fig. 4* shows (based on the best available data) the relative costs of fleets of aircraft of differing types—the fleet size being dependent on both stage length and aircraft design—all capable of the same amount of transportation work at a common load factor. By virtue of its higher speed the jet is shown to reduce markedly the amount of capital that has to be tied up.

Scope : It only remains to demonstrate that a jet aircraft of the class in question is in fact a missing part of the pattern of equipment available. *Figs. 5* and *6* show the areas of profitable operation, the upper and lower bounds being fixed by maximum and break-even payloads respectively, for a number of established and new airliners. *Fig. 5* relates to propeller aircraft now in service, and shows that the traffic offering in the work capacity band indicated by shading is large enough to support the operation of at least three principal types; the number of aircraft of these types in service is nearly 1,000. *Fig. 6* shows the corresponding data for " up-to-date " aircraft; the shaded area is the same as that in *Fig. 5*, and is seen to be unoccupied by any new design—except Aeroplane ' X '.

The answer

What sort of aeroplane is this " missing link "—which appears as Aeroplane ' X ' in the foregoing? The *Hunting 107 (Fig. 7)* has been evolved over a period of several years as the answer to this need.

As implied earlier, it is deemed necessary to have a design in which the major advantage of jet propulsion—which is an enhancement of the only basic merit which air transport offers, namely speed—can be realized without recourse to such elaboration as causes a deterring increase in design and development cost and in first cost of the aircraft. This means a cruising speed not greater than about 450 knots (M=0.78). Such a limitation, when a relatively small aeroplane is involved, ameliorates structural, control system, high lift device and other system complexities, and keeps the problems well within the present state of the art.

The 107 design is essentially a 48-seat aeroplane, with two jet engines, of either the pure or fan/by-pass type, mounted externally on the rear fuselage, and a low wing of modest sweepback working at a moderate loading. It provides comfortable 4-abreast seating, with adequate passenger and crew amenities. It is hardly necessary to say that full anti-icing, air conditioning and pressurization systems are incorporated.

The all-up weight will not exceed 45,000 lb, the span 80 feet and the height 24 feet. Compartments for baggage and light freight are provided both above and below the cabin floor.

If a sufficient demand could be generated—and the foregoing has surely established that there is no reason at all why (say) 100 aeroplanes could not easily be taken by operators to their advantage—it is believed that the selling price would be kept below £300,000.

The performance is as follows : This aeroplane can cruise at 435 knots with a comfortable power demand from the jet engines and a margin in hand from Mach number effects on drag characteristics. The airfield performance is notable; considering operation at maximum take-off weight, the airfield size required for both take-off (with engine failure) and landing is under 4,500 ft for standard sea level conditions, and under 5,000 ft for either an airfield elevation of 3,000 ft or a temperature rise of 23°C.

All established airworthiness performance requirements are easily met.

Depending on the engines used—ordinary or by-pass jets—full passenger payload can be carried for 700 nautical miles or 1,000 miles (with SBAC IFR fuel reserves and allowances). For stage distances less than 400 (or 800) miles, a light freight load of 2,000 lb can be carried in addition.

Air Traffic Control
Data Handling and Display Equipment

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Air Traffic Control first plans, and then controls, the movement of traffic. The equipment used today by the movements planning section of an air traffic control centre is entirely manual and mechanical, being based on the well-known flight progress strip. The static data contained on the strip are received in the centre by various means, principally teleprinter and telephone: the available information is not therefore in a form in which it can be fed directly into any sophisticated presentation system.

The primary method of control of the traffic flow today is still procedural. Radar control is used in a supplementary manner; but in most places radar coverage is still incomplete, and the equipment, by modern standards, is rudimentary. Because of the limited radar coverage available, the dynamic positional data on which procedural control is based is obtained by R/T position reports from aircraft: these reports are inaccurate, first because of the inadequacy of airborne navigational aids, and secondly because of delays in transmission to the control centre.

Because of these facts, traffic separations are large—in fact, comparable to those in use in the 1930's. *Improvement must be sought in two directions: first, in providing much better information for the flight control section* of the control centre, and aids for the control officers in taking decisions; this will render closer separations safe and give better spatial use of the airways. *Secondly, improved methods of traffic planning are required to ensure that the increased space made available by better control can be utilized.*

Even with complete radar coverage, the flight control section is still not adequately equipped. Present radar displays show the plain "raw" radar, often with a video map superimposed; but the control officer is still without, first, means of extracting accurate ground speeds on aircraft, which could make procedural control much more effective: secondly, any means of establishing the identify of a particular radar response (except by an identification turn, which may infringe mandatory separations), or of retaining the identity of a response once established, which is a problem where traffic is dense: thirdly, aids to help him to decide quickly whether an apparent impending conflict between two aircraft will actually occur. His presentation contains a very large amount of irrelevant information, such as rain and ground clutter and responses from aircraft in which he is not interested.

New techniques

The most important contribution towards the solution of these problems has been the development in recent years of interscan display systems. These enable information to be added to the raw radar picture, and aids to be provided to reduce the workload on the control officer. It is also now possible to provide synthetic displays for executive officers, on which additional information, besides that in the raw radar picture, is provided on tracks which are of interest, and all irrelevant information is suppressed. Some of the facilities available in the Decca system will now be described: equipment containing these facilities is, with the exception of coloured displays, either in service or on order, and most of the features described have been in operational use for several years.

Measuring and track lines: Superimposed on the raw radar picture, one or more lines can be created electronically on the display, which may be used either to measure the bearing and distance of any point on the display from any other point, or may be set up as track lines (for example, from the last reporting point in an airway to the point of final turn onto the approach). Bearing and distance are indicated on accurate scales (see *Fig. 1*).

Extended runway markers: The approach controller or director can be provided with interscan lines representing extensions of the centre lines of the runways in use, the approach marker being calibrated with bright spots indicating distance from the end of the runway. Special measures are taken in this case to ensure stability of the markers, and means are provided for very rapid checking and adjustment if necessary by the controller himself (see *Fig. 1*).

Fig. 1: In addition to the video reference map of controlled air space this approach control display at Schiphol Airport, Amsterdam, shows four variable electronic runway markers, also a 30° fan for the dispersal of aircraft after take-off and an interscan circle for target tracking (on innermost range ring). The latter can be converted to a radial line (or secant) for the accurate measurement of a target's range or bearing. A second circle, likewise convertible to a track line, can also be switched in.

Fig. 2: Two photographs, each showing half a PPI, taken during automatic tracking of three aircraft. The flight path already covered can be seen from the thick afterglow tail, and the lines from the front of the target are prediction vectors showing automatically computed speed (length of vector) and direction. (The photographic exposures cover several aerial rotations.)

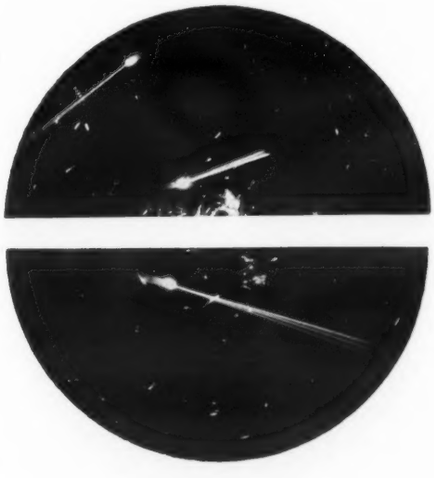


Fig. 3: A synthetic or filtered display, in which five different symbols are used to mark different aircraft, categories of individual targets being identified by "electronically written" track numbers. A video map picture can also be presented, and prediction vectors can be incorporated if required. Additional electronic numbers could indicate height. This type of presentation is particularly suitable for large-screen synthetic displays.

D/F bearing lines : A valuable aid to the identification of radar responses with individual aircraft is an interscan line on the radar display indicating VHF D/F bearings. When a VHF transmission is received from an approaching aircraft the D/F line, which extends from the D/F site to the edge of the display, " points " in the direction of the transmitting aircraft, and generally overlies its radar response. If more than one D/F line is used on a single display, a fix can be obtained. D/F lines can be run at very low brilliance, and there is no undesirable cluttering of the radar presentation.

Interconsole marking : Interscans also take the form of symbols which can be made to appear simultaneously on more than one display. A controller can therefore hand over an aircraft to another selected controller by marking the aircraft response on his radar display with a symbol; the receiving controller thus has positive indication of his new aircraft without the need for excessive speech.

Tracking markers : Interscan symbols can also be used as tracking markers : a symbol is placed by an operator on an aircraft response, and made to follow it by either semi-manual or automatic means. This facility can be used in conjunction with raw radar displays to mark aircraft in a particular category, for example, overfliers. If it is required to mark more than one class of aircraft, different symbol shapes can be used. The track and ground speed of any aircraft being tracked is available in the equipment, and may be presented if needed: speed would be particularly valuable for procedural control.

Track numbering : Numbers and letters can be written on a radar display electronically, and may be associated with, for example, tracking markers. In systems where a number of aircraft are being tracked, the use of electronic track numbers permits the aircraft to be distinguished, not merely into categories, but individually. This facility becomes essential in large systems employing synthetic displays. It is also possible to indicate other information, such as height, by means of such numbers; letters are equally easy to create.

Conflict prediction vectors : Interscan lines may be attached to tracking markers so that their direction indicates the track of the aircraft, and their length the distance which the aircraft will travel in a time set in, by means of a single knob, by the controller: the ends of the lines therefore represent the future positions of all aircraft at the time chosen. If two aircraft are suspected to be steering collision courses, the time control (which operates on all prediction vectors on the display) can be turned up to see whether the aircraft will ever conflict (see *Fig. 2*). This is an elementary example of an electronic computation, integrated with the display equipment, which can materially help the control officer: much more complex computations have been provided in air defence systems, and could equally be employed in air traffic control systems if needed.

Synthetic displays : An extension of the principle of tracking aircraft with markers is used to create fully synthetic (or filtered) displays. If on one or more displays showing the raw radar picture tracking symbols are placed on all aircraft responses which are of interest, these symbols can be reproduced on other displays from which the raw radar picture is absent. This type of display is free of clutter and unwanted aircraft responses, but can be provided with all relevant facilities described above (see *Fig. 3*). The control officer is thus presented with an extremely clear picture, with supplementary information and aids, but without any unwanted information. This type of presentation becomes highly desirable in systems handling heavy traffic, and may be associated with tabular displays containing supplementary track information.

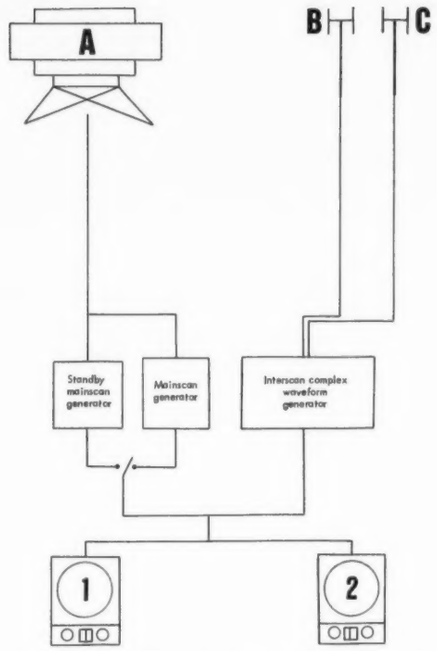


Fig. 4 (System I): Block diagram of a control system for relatively light air traffic. Sources of information are: A. surveillance radar (duplicated mainscan generator); B and C. two VHF D/F stations (both can be switched electronically to PPIs 1 and 2; one can be converted for use as an auxiliary station if required).

Comprehensive displays : It has been assumed above that all positional information comes from radar. The positions of symbols may, however, also be controlled by data derived from sources other than radar. Examples of other sources are an airborne navigational aid in conjunction with an air-to-ground data link, a D/F fixing organization, and (when available) secondary radar. It may be noted that for example on the North Atlantic route a single display can be provided which accepts radar information on aircraft within radar coverage, and positions received over a data link on more distant aircraft.

Large screen displays : By projection methods general situation displays have now been built as large as six metres square. It appears doubtful whether so large a presentation is required in air traffic control; but small displays of this type (giving a picture of about two metres square) are available and may be required. This type of display, which is always of the synthetic type, will shortly be able to provide a coloured presentation: it is provisionally suggested that the best use of colour is to divide the air space into several height bands, which will enable a very high proportion of apparent conflicts to be immediately resolved.

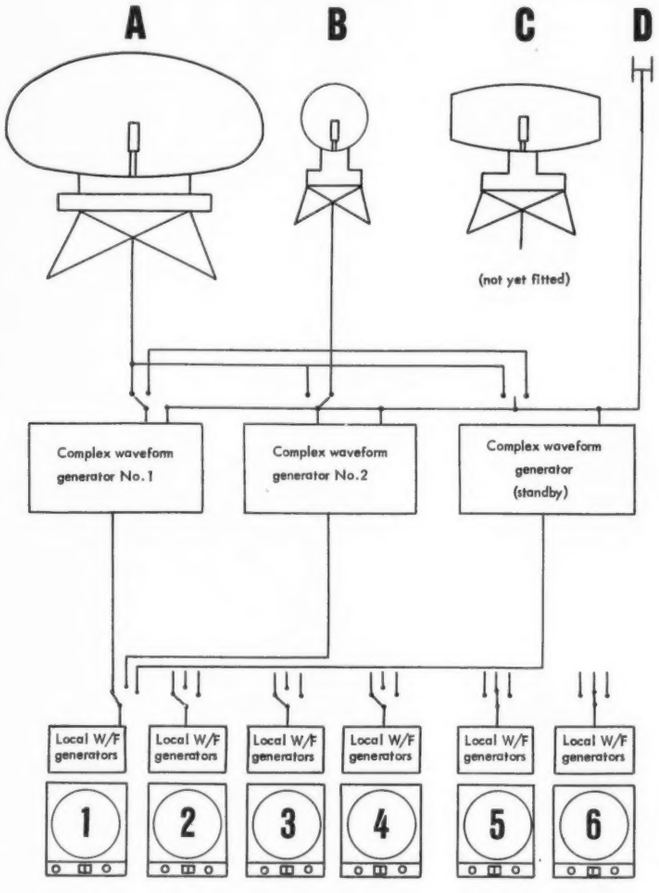


Fig. 5 (System II): Block diagram of a control system for moderate density air traffic. Sources of information are: A. long range surveillance radar; B. approach control radar; C. medium-range surveillance radar (not yet fitted); D. 6-channel VHF D/F station. PPIs 1 to 4 are for *airways control*, each display providing the following facilities: normal radar picture, D/F line, measuring or leading line, interconsole marking. PPIs 5 and 6 are used for *approach control* and offer the following facilities: normal radar picture, D/F line, measuring or leading line, interconsole marking, extended runway markers.

Three typical systems

To illustrate the wide variety of systems which can be engineered to meet different requirements, three examples are now given of equipment for flight control. The first is for use in an area of comparatively light traffic density, while the

second is for a medium density traffic area. Both of these systems have been planned by Decca Radar Ltd. to the requirements of European civil aviation authorities; System I is presently being installed at Stockholm. The third scheme illustrates the type of system which would be suitable in an area of high traffic density; this system is not based on the requirements of any particular centre, and it will be observed that, looking ahead a few years, positional information is assumed to be available from sources other than radar. In all other respects this system can be built today.

System I (Fig. 4): The block schematic diagram of this simple system is virtually self-explanatory. It will be noted that a standby mainscan generator is provided to ensure that the raw radar picture is always available; the interscan complex, which generates the additional interscan facilities, is not duplicated.

System II (Fig. 5): This is a much more ambitious scheme, involving the use of two radar heads immediately, and a third at a later date. The airways control and approach control buildings are located some 300 metres apart; nevertheless, it was a requirement to provide an extremely high degree of flexibility in the interconnection of the elements of the system to ensure that both airways and approach control could continue to function in the event of either radar or display system failures. The special facilities requested are quite comprehensive, including the provision of auto tracking markers for designating overflying aircraft in airways control.

System III (Fig. 6): In this scheme synthetic displays are provided for the control staff, fed from a data store. Beside each plan display is a tabular presentation containing supplementary information on aircraft under control (for example, ground speed), and a second tabular display of a facsimile type (Deccafax) presenting static information (e.g. meteorological information, alternates available, etc.). The data sources are shown as one radar, a D/F fixer service, position reports received from aircraft over a data link, and secondary radar, it being assumed that aircraft heights will be transmitted through the latter two sources. This arrangement is schematic only; in practice it is to be expected that there will be more than one radar source. A small projection display is provided for the supervisor showing all movements in the Flight Information Region. A military liaison officer is shown, adjacent to the supervisor, who is provided with equipment similar to the sector controllers: in addition to providing liaison on scheduled military flights, this officer would also be responsible for watching for intrusion into airways by unscheduled military aircraft such as fighters. It should be emphasized that, apart from the inclusion of certain data sources which are not immediately available, the principles of operation employed in this scheme have been used in air defence operations room equipment already delivered.

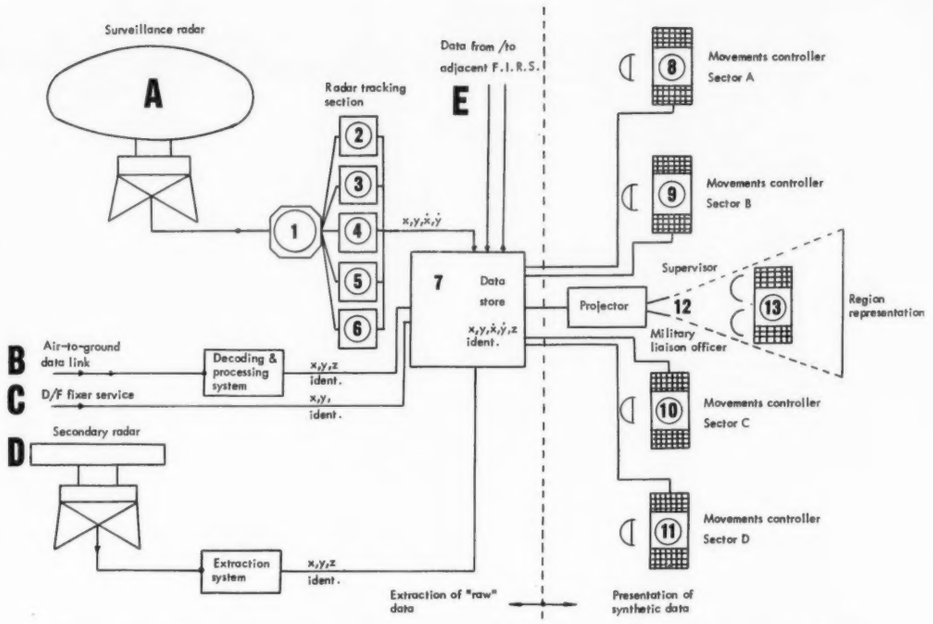


Fig. 6 (System III): Block diagram of a hypothetical control centre for high density traffic. Sources of information are: A. several surveillance radars; B. data link for reporting aircraft positions and heights; C. automatic VHF D/F fixer service; D. secondary radar; E. automatic supply of data from neighbouring traffic control areas. The " raw " radar pictures are evaluated in the displays of the radar tracking section (1 to 6) and fed into the data store (7), where they are mixed with additional information and passed to the synthetic displays of the movements control section (8 to 11). The supervisor and his military liaison officer have at their disposal a projector (12) giving them a view of the general situation, and a military control desk (13).

Comprehensive systems

Systems have been under development both in America and in Europe employing digital computers to store flight plans which have been filed, compare actual position reports with flight plans, and discern conflicts between controlled aircraft within the Flight Information Region. Provision is also made whereby an aircraft captain wishing to file a flight plan can verify before doing so that, at that time, no conflict exists.

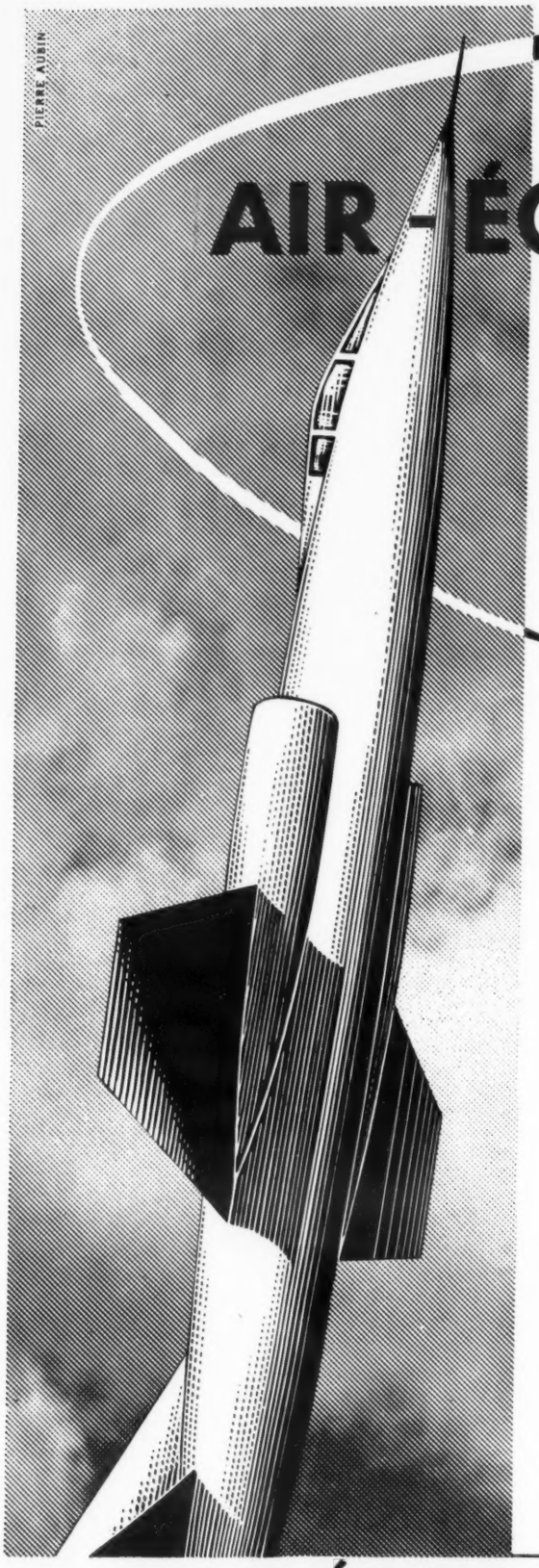
Another system, under development by Decca Radar Limited, differs from most, if not from all, other Air Traffic Control systems in that it possesses a large store of precomputed flight programmes. When an aircraft enters the system it is immediately " labelled " with the programme that most nearly coincides with its proposed flight throught the system. The aircraft is informed of the details of the programme allocated to it: if necessary it is asked to modify very slightly its flight so as to conform exactly to the programme. Such modifications will be very small, as the programme store is so large that close correspondence between the aircraft's intentions and an available programme is assured.

Since in this system all aircraft are flying to known precomputed programmes, it follows that all future conflicts are known from the moment of entry of any new aircraft into the system. The need for continual searching for potential conflicts is thus avoided. These precomputed programmes exist in the electronic store in a form compatible with the track position data from radar: whenever any lack of correspondence develops between the allocated programme and the actual behaviour of the aircraft, an alarm is given when the discrepancy exceeds a predetermined amount. It should be noted that this alarm will be given long before any conflict could be seen to have developed.

It is important to note that this system can be used in two distinct ways. By the first method it can provide precision monitoring of traffic movement, in comparison with the allocated traffic programmes, and provide the controllers with accurate predictions of the traffic configurations at any number of minutes ahead (up to 60 minutes). For example, if two aircraft flying down converging airways are approaching a point of potential conflict where the airways meet, the system can at any time state which aircraft will arrive first, and by how many minutes. Operated in the second way, the system can also eliminate the need to stack inbound aircraft near the terminal (except in fog, when the blind approach and landing systems at present limit the landing rate below normal). When an aircraft reports at the entry to the Flight Information Region, and the precomputed programme which, on the basis of its intentions, would normally be allocated to it would result in a conflict, the aircraft can be offered one or more alternative programmes. These will in general be one of two types: either a programme calling for a slower cruising speed, which will ensure immediate landing on arrival at the terminal area, or a programme conforming to the aircraft's normal flight performance but starting some minutes later, and therefore requiring a holding manœuvre just inside the F.I.R. Both alternatives can be offered to the pilot, who will be free to choose which he wishes to adopt. This procedure has been called " Indicative ", because the ground control indicates to the aircraft what courses of action will enable it to make an immediate landing on arrival at the approach control zone.

There are clearly several advantages in controlling traffic in this way. First, it avoids the stacking of numbers of aircraft close to the terminal, where traffic is in any case congested, and radar identity is lost. It is also believed that most captains would prefer to reduce cruising speed or to hold for a stated time just inside the F.I.R. rather than be stacked in the present manner; in the case of the more modern aircraft, to which stacking at low altitude is highly uneconomic, the advantages appear outstanding.

Finally, it may be observed that, in the planning of the air traffic pattern, the present practice of applying " yes/no " tests to requests for clearances is not calculated to make best use of the airspace. If a gap exists between flights already in progress which could accommodate two aircraft, there is nothing in the present system (or in most proposed systems) to prevent a single aircraft being accepted on timings which preclude the acceptance of a second additional aircraft. The system described above would prevent this; it thus appears to be the logical complement to the improved equipment of the control of traffic, which, if successful, will make more airspace available.



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FIAT
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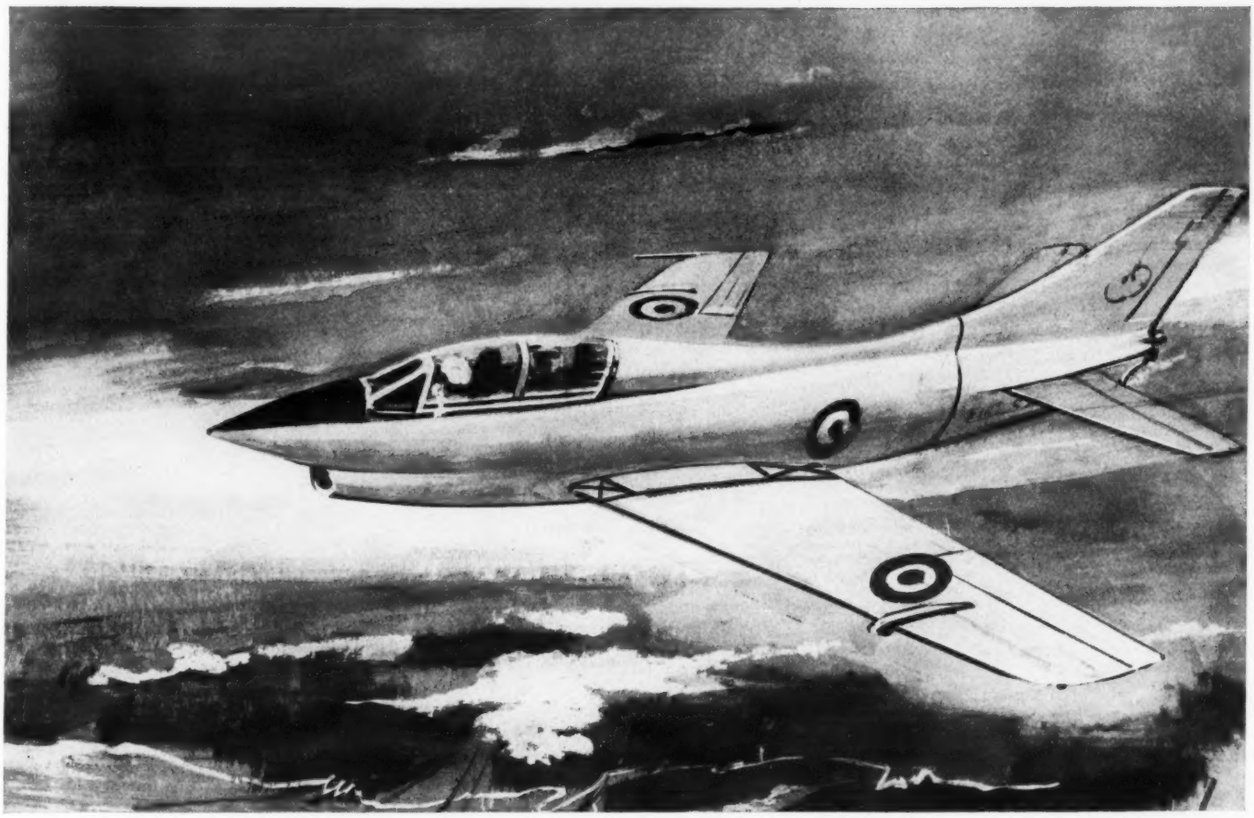

FIAT'S NEW G.91 T

JET TRAINER

(Bristol Orpheus 80302 Engine)

— The transonic Jet-Trainer is derived from the G.91 lightweight strike fighter, winner of the NATO contest, and is specially designed for advanced training.

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FIAT - DIVISIONE AVIAZIONE
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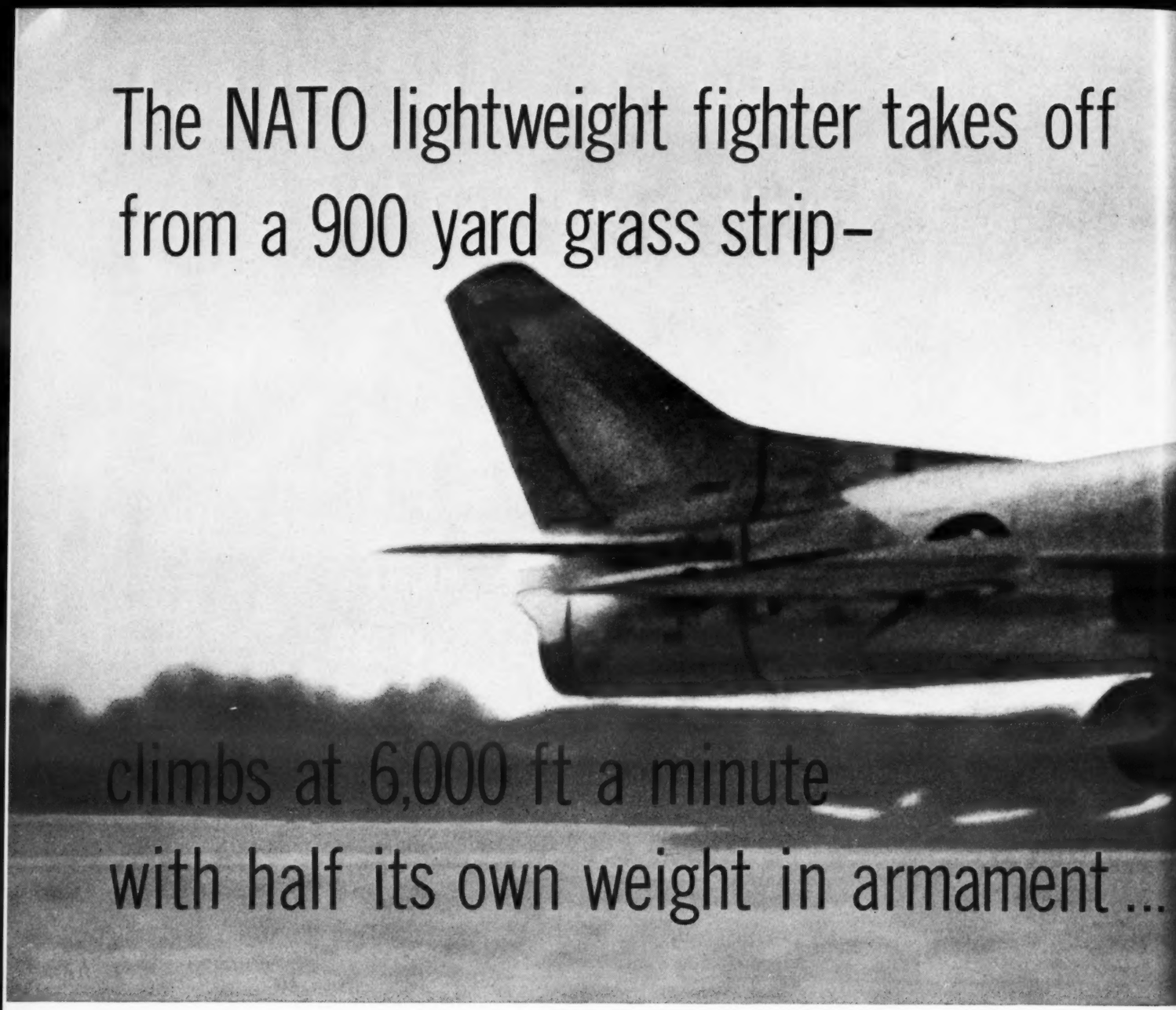
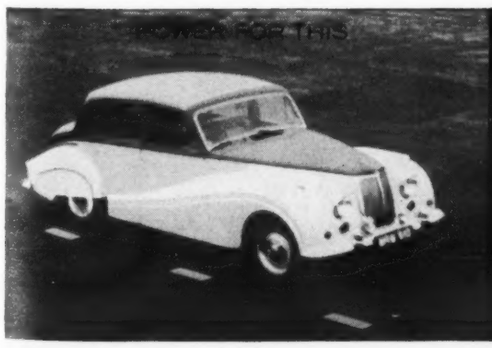

The NATO lightweight fighter takes off
from a 900 yard grass strip–
climbs at 6,000 ft a minute
with half its own weight in armament...

...AND BRISTOL SIDDELEY

One of the largest manufacturers of motive power units in the world, Bristol Siddeley Engines Limited produce the Orpheus. The Orpheus is the most advanced medium-thrust turbojet engine in service anywhere today and has been chosen for the NATO standard lightweight strike fighter—the Fiat G 91. Orpheus versions range from 4,050-lb thrust dry to 8,800-lb thrust with reheat and reach power/weight ratios of up to 6:1. They are already in service in 6 different aircraft types, specified for 8 others and are flying or licensed for building in India, Finland, Jugoslavia, France, Japan, USA, Italy, Germany.

BRISTOL SIDDELEY ENGINES LIMITED

SUPPLY THE POWER



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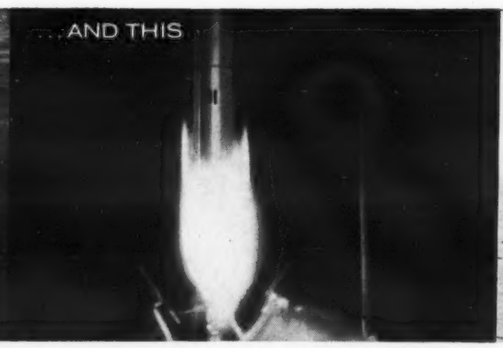

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The Bristol Siddeley Marine Proteus powers the "Brave" class Royal Navy patrol boat, built by Vosper Ltd. Three Proteus deliver a total of 10,500 hp—give these 96-ft boats a speed of over 50 knots. The marine Proteus is quick-starting, flexible and reliable.

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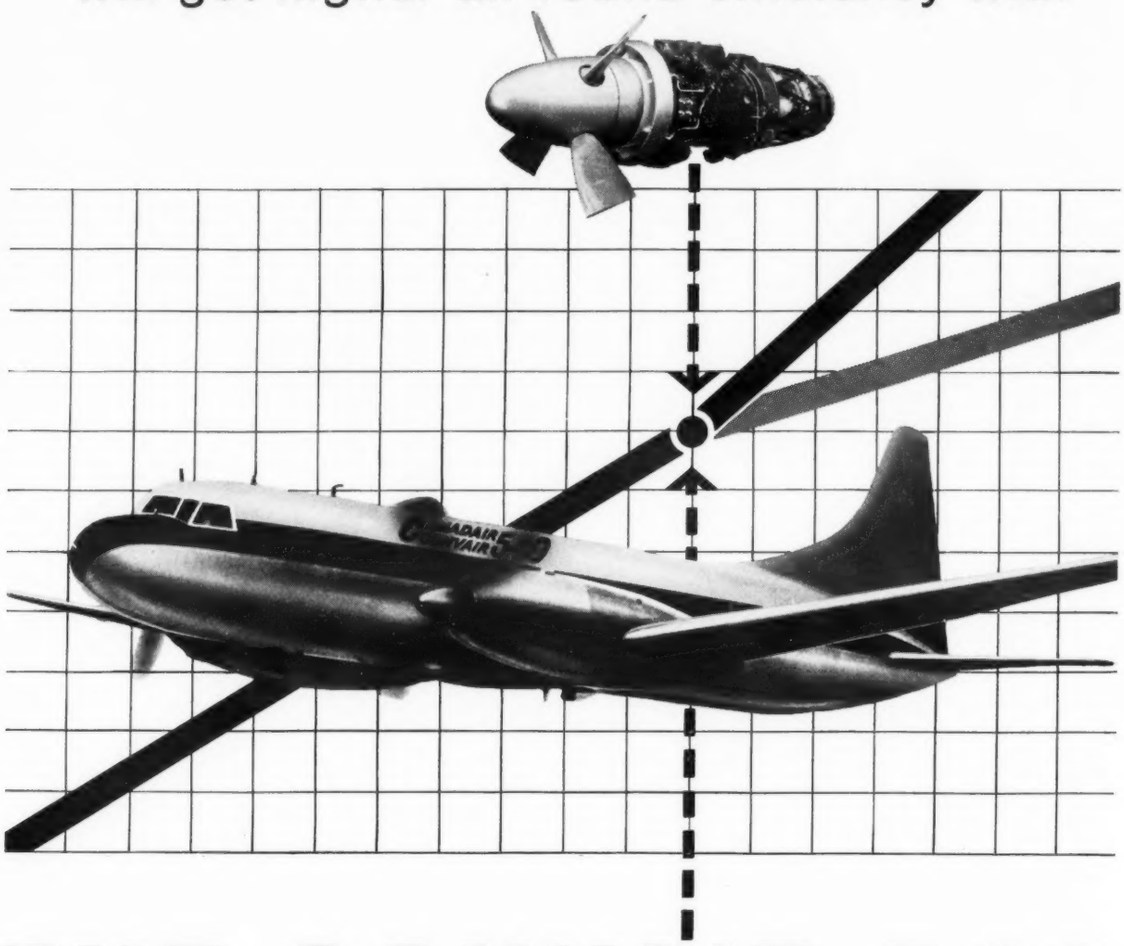

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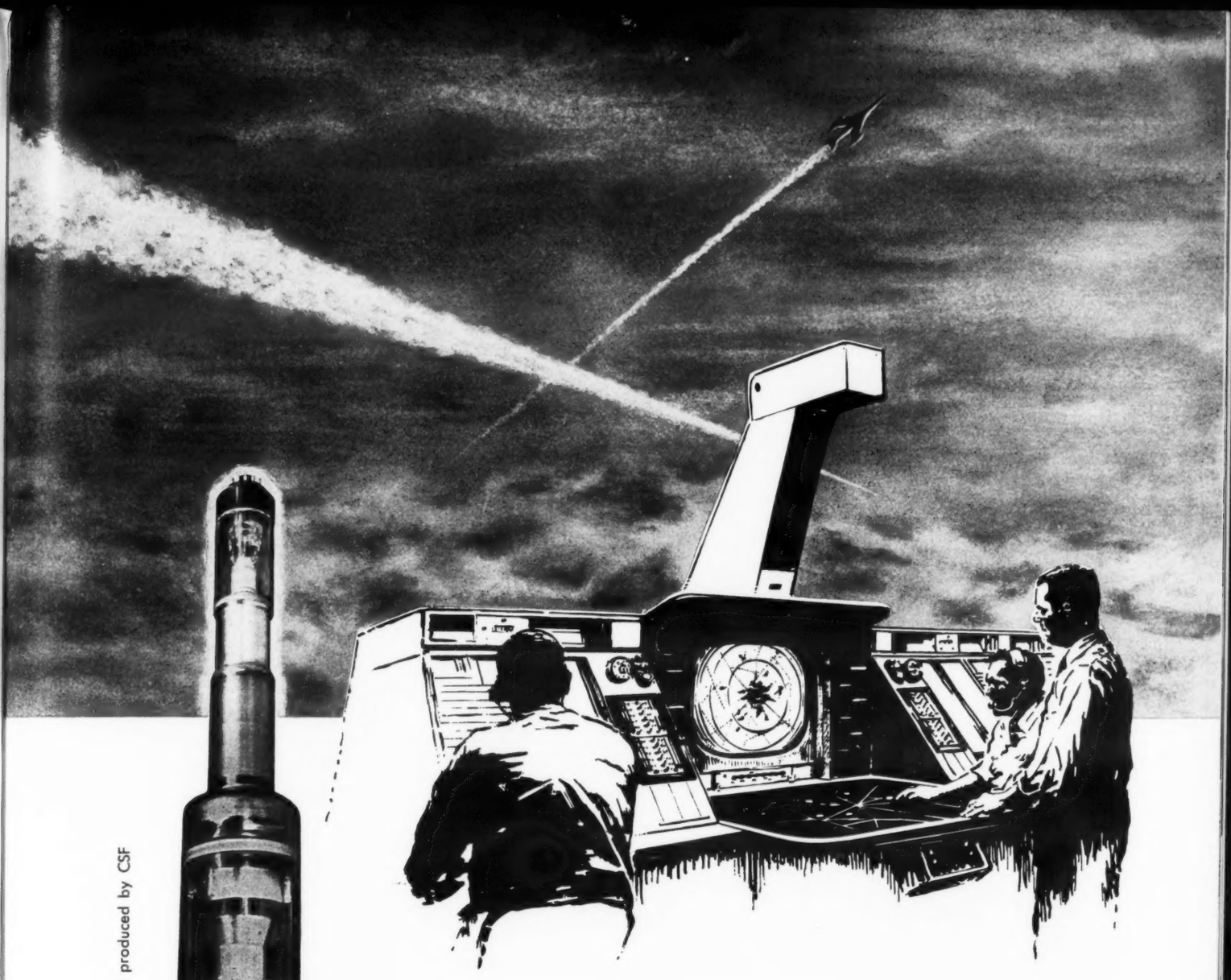

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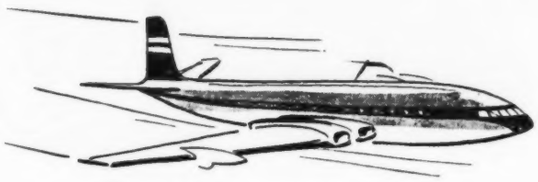

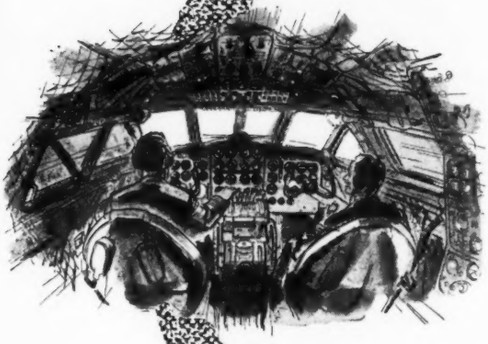

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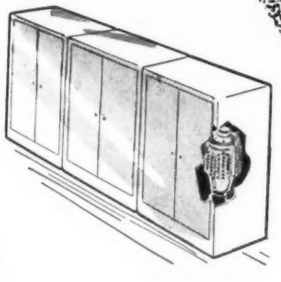

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Flight planning

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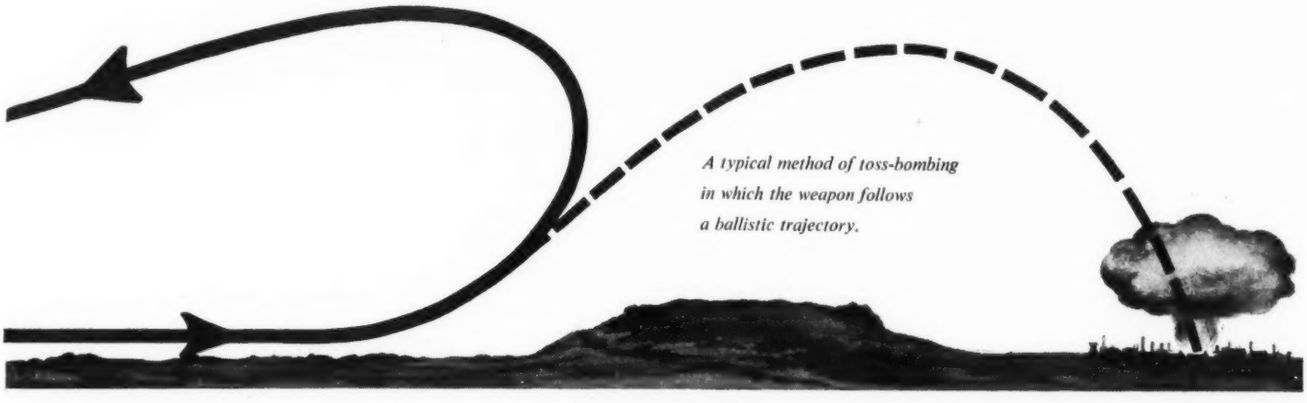
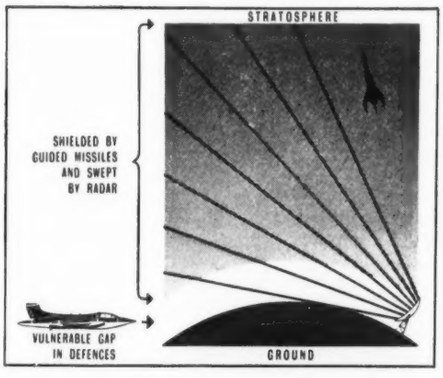
"The NA.39 is ahead" *



A typical method of toss-bombing in which the weapon follows a ballistic trajectory.

The most advanced systems for low-level, high-speed, all-weather weapon-release are installed in the NA.39, thus ensuring precise delivery of conventional or nuclear weapons.



* *"In the low-level strike role, the NA.39 is ahead of any other aircraft in the world."*
Ministry of Defence.

Blackburn

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FARNBOROUGH 1959

A few weeks ago a prominent member of the British aircraft industry made the following portentous statement to a friend from abroad : " We shall be having a General Election this autumn, and I think it more than probable that the new Government will be the same as the old one. But with this 'new' Government will rest the decision on whether Britain shall still have an aircraft industry in 1960 ".

A somewhat outspoken comment. Yet no amount of glossing can conceal the fact that this year the " British aircraft industry's shop-window "—the annual exhibition and display organized by the Society of British Aircraft Constructors—was less richly decorated than usual. This was no mere chance. It was the consequence of certain measures which were introduced, perhaps a little over-hastily, by the 1957 White Paper on Defence. It was also the consequence of the economy policy which is becoming more and more conspicuous in the defence budgets of all countries. And finally, it was the logical result of the fact that not armaments but diplomacy has the word today.

That in reality there is a well-thought-out plan behind everything the visitor saw at Farnborough is revealed by the following article from Interavia's *military writer, General L.M. Chassin, who comes to the conclusion that when all is said and done there has been no change in the basic planning for Britain's air and sea power. The industry has merely had to adapt itself to two factors : the change-over from conventional to new weapons and the recent reductions in military orders. Farnborough 1959 was thus the clear expression of a transition to a new age.*

Compared with earlier years when pride of place among the aircraft demonstrated was given to military models, the accent this year was clearly shifted to civil equipment. The British principle " export or die " today applies more firmly than ever before to an aircraft industry whose military funds are cut from year to year. Whereas in the U.S. aircraft industry military contracts still account for 80 per cent of all business, in the British industry this percentage has now fallen to 50.

Will there still be a British aircraft industry in 1960 in these circumstances ? The question has already been answered in the affirmative. In this period of transition to a new type of armament the Government has awarded bigger contracts than ever for civil and military transport aircraft. Under this transition the old Government, which hopes to remain at the helm, has granted generous new credits for research and development on engines and equipment. Admittedly, the number of new aircraft types demonstrated in 1959 was relatively small. But new transports, new supersonic airliners, new STOL and VTOL equipment are in preparation, and intensive work is in hand on new missile projects.

Britain's Air Strategy

by General L. M. Chassin, Paris

In order to form a clear picture of the military doctrine of a country, it is obviously helpful to study the official statements of its ministers closely and to read its White Papers with care; but it is still more profitable to closely examine its budget, the manpower of its forces, and above all to consider the equipment it produces.

In the end, all theories must eventually be translated into practice. A war is ultimately fought by men and weapons. If these are inadequate it is of little importance that the theory was sound. In 1914 the French theory of the sustained offensive failed because the armour necessary for its application did not exist at the time.

Also, the establishment of an equipment programme for a country depends on the most sensible combination of its strategic and tactical thinking. Being in possession of the actual prices, it is necessary to consider the problem at length before commitment. In the years between 1918 and 1940 would so many cruisers have been built in the world, had it been thought that they would serve for nothing and that they would represent just so much money literally thrown in the sea ?

Throughout history, there are periods of stability when methods of warfare become well-defined, theories established and consequently little change in arms. Unfortunately there are also periods of change in which the pattern of future wars is unknown.

At present we are in one of these periods of change. Faced with formidable technical progress on one hand, and on the other by the appearance of forms of warfare which were thought to have disappeared (war described as subversive, revolutionary or politico-military—the last term appears to be the best), we do not know what might happen tomorrow. To cover all eventualities it would be necessary to prepare for all types of war ! Atomic war (total or limited), conventional warfare without the employment of nuclear explosives, and finally subversive warfare.. Regrettably only the USSR appears to possess the complete armoury. For various reasons the West appears unable to mobilize a number of combatants relative to the size of its population and faces 200 Soviet divisions with 20 Western divisions. The field of subversive warfare has scarcely been studied until now except by France, and no doubt the Western nations are unable to realize accurately the dangers which it holds for them.

In the atomic field, an over-confidence which existed thanks to the nuclear monopoly and to superiority in the means of delivery, has been succeeded by anxiety, verging at times on unjustified panic, as a result of Russian successes with ICBMs and satellites.

Certainly the Americans are still in a strong position. If they show themselves capable, as is certain, of withstanding the first attack without a weakening of morale, they would always have the opportunity of transforming the conflict, whatever it may be, into a major atomic war and engaging the aggressor in mutual suicide. It is on this delicate " balance of fear " that the fragile peace we enjoy at the moment is based.

One feels that such a theory is hardly satisfactory, and while the statesmen rush distractedly after a disarmament plan which always escapes them, all the world's theorists seek to prop up systems of "graduated deterrents" or of "partially defensive strategy" to enable the world to escape the dangers of a conflagration where western civilization would perish.

But if the United States, leader of the coalition of free peoples, fumbles and hesitates, one can imagine the difficulties that would face a European nation such as Britain, in defining its policy and choosing its equipment.

•

Until recently, before the appearance of missiles, the situation was relatively simple. On one hand it was necessary to oppose the entry of enemy bombers over national territory, that being the duty of Fighter Command, and on the other to participate with other allied forces in the attack on the enemy potential, that being the work of Bomber Command.

Given these two basic problems—the others being to some extent secondary—the solutions could be found. Knowing with reasonable accuracy the numbers and performance of bombers which could attack Britain, it was possible to establish the characteristics of the radar and fighters capable of carrying out an interception at a given distance—50 miles for example—from the English coast. The number of control stations and fighter squadrons necessary could then be calculated. Agreed, saturation or diversionary tactics would always enable some attackers to get through, and given the power of nuclear explosives the scale of destruction would be immense. This, however, was a matter for civil defence and of morale, and that of the British is well known to be high. It was nevertheless, hoped to reduce the numbers of attackers who crossed the coasts to the minimum.

Similarly, for attack it was possible to calculate the number of megatons necessary to annihilate the enemy's potential and destroy his will to war. This being done, the tasks were divided between the Americans and Bomber Command, each undertaking the responsibility for a certain number of targets. It should be noted in this connection that the possession of its own atomic bomb and the means to deliver it, enabled the British Government to make its voice heard in the designation of targets, opinions as to their relative importance being somewhat different on this side of the Atlantic to the other.

The modernization of the RAF's V-bomber fleet is in full swing. Though today it still consists preponderantly of *Valiants*, the number of *Victors* and *Vulcans* is steadily increasing. Three Handley Page *Victors* of Bomber Command are seen here on a training flight.

Furthermore, being in possession of all available information on the strength of Russian anti-aircraft defences (radar and fighters), it was possible to establish a certain loss factor and to calculate the number of aircraft to employ to obtain a desired result.

Unfortunately, this simple system has collapsed with the arrival of ballistic and guided missiles on the scene. No doubt the day will come when all that we have said will become applicable once again when missiles are guided from start to target, and air battles, instead of being aircraft against aircraft, will be missile against missile.

New combats will then be seen between attackers and defenders, with the difference that the directing human brains—for they will still be needed—will remain on the ground in deep shelters, and the opposing pilots will follow the enemy on their radar screens and manœuvre while thousands of miles apart.

For the moment, however, we are in an uncomfortable intermediate period, where the aircraft and the missile coexist, where the anti-missile missile has not yet become fully developed and the long-range missile remains partly ballistic, that is to say that for the greater part of its travel it obeys only the laws of physics.

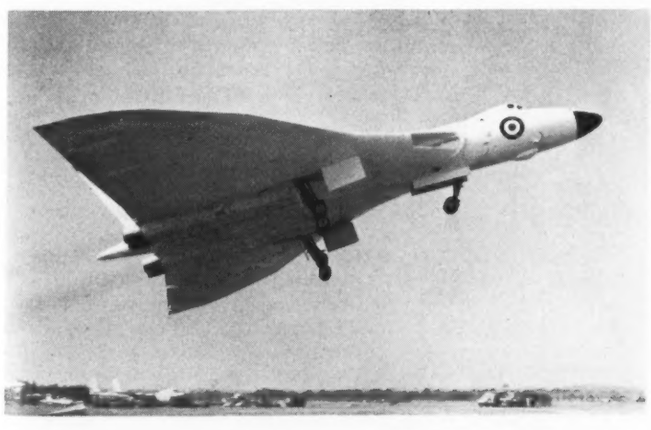
In the field of strategic planning, we are in a period in which Britain still has world-wide interests to maintain, and where it is consequently necessary for her to think not only of Europe but of the more distant regions of Africa and the Far East. Mr. George Ward, Secretary of State for Air, explained this clearly in the last issue of *Interavia* review: "The strategic deterrent is only one of the Royal Air Force's tasks. Air defence, reconnaissance, tactical operations, patrolling, Army support, transport of troops and equipment, maritime work, are all vitally important in home and overseas theatres."

In Britain, therefore, these requirements must result in a flexible strategy, both cautious and well-considered, which enables her to fulfil a role worthy of her traditions and to maintain her political importance in the interallied councils.

The primary task remains that of deterrence, based on a combination of missiles and aircraft, the importance of the former increasing as they develop in performance and efficiency. In 1957, in the revolutionary White Paper, it appeared that the British intended to abandon the use of aircraft and apply all their potential to the creation of a nuclear guided weapon striking force. It seems that a number of factors such as the multiple difficulties encountered in the development of long-range missiles such as the *Blue Streak*, the problem of converting an industry in full prosperity and the attendant possibility of its falling into a recession, and not least the opposition of high-ranking personalities in the RAF, have made them modify their programme. In fact the modernization of the V-bomber force is being carried out vigorously. Although today it is armed for the greater part with *Valiants* (61 percent approximately), the numbers of developed *Vulcans* and *Victors* similar to those seen at Farnborough continue to increase.

Thanks to this wise procedure, half the V-bomber force will be modernized in the coming year, as will be the light bomber force, which is also capable of carrying the atomic bomb.

The most important modification of principle, however, consists of the adoption of the new conception of the air-to-ground aircraft missile, which offers the advantages of reducing the vulnerability of the bomber and increasing the range of the missile, at the same time providing



The Avro *Vulcan Mk.2* V-bomber, one of the command in the years to come, is to carry the *Blue Steel* stand-off bomb with hydrogen warhead.

greater security for the missile owing to the mobility of its launching site.

The idea stems from the Navy, and to many observers the submarine armed with an IRBM appears as the most formidable weapon of the future. A permanent ground launching base will always end by being registered, attacked, and finally destroyed, whereas a mobile launching base can escape from atomic counter-attack more easily. While ground-based missiles may attain this mobility, as the V2 did to a certain extent, the submarine retains the advantage of a water screen which up to the present is impervious to radar search. While this latter advantage does not obtain in the case of an airborne carrier, the speed at which it can be brought into action is unmatched, provided that the problem of

The Bristol/Ferranti *Bloodhound*, Britain's first operational anti-aircraft missile system, was demonstrated at Farnborough by No. 264 Fighter Squadron, RAF. The operating crew comprises five men... and a sturdy squadron dog.

placing the missile on its flight path with sufficient accuracy can be overcome. However, the progress being achieved in automatic navigation will make it possible in the near future to hit any target with a missile launched from an airborne platform travelling at supersonic speed.

In consequence the *Blue Steel* air-to-ground bomb (stand-off bomb), which has been tested on the *Valiant* and the *Vulcan* at Woomera, and which should go into service in 1961, will increase the deterrent force of the RAF by giving the piloted bomber an extended lease of service.

The third panel of the picture is that of the pure missiles. It is known that the British, while accepting the American *Thor* IRBM without hesitation (they have 4 squadrons totalling 60 missiles, one being already operational), intend to have their own long-range ballistic missiles armed with nuclear warheads of their own manufacture. After the successful trials of the *Black Knight* experimental vehicle, the *Blue Streak* is now going into production. With its 2,800-mile range, Rocketdyne motors built by Rolls-Royce, Sperry guidance system and Bristol Siddeley vernier motors, it will enable the British to overcome the "double key" problem, a British key and an American key which, no matter what the relationship between allies, threatens the loss of minutes at a time when each second is vital.

Thus the British interpretation of the policy of deterrence shows a sound pattern of ideas, a desire to avoid too sudden change, and a strong spirit of national independence—features of the character which has always been the strength and glory of Britain.

*

In these days of fear and insecurity, what will become of the air defence forces? Here also the British are cautious. They appear to admit that for several years to come the Russians may attempt to attack their territory with piloted bombers, or at least in part. Consequently they are retaining Fighter Command, which now appears in three forms: conventional piloted aircraft, piloted aircraft carrying air-to-air missiles, and lastly ground-to-air missile batteries. The development here promises to be the same as for the bomber forces with a growing emphasis on missiles.

There would seem, however, to be an important reason which compels the British to retain piloted fighters. That is so they may be employed outside the air battle to intervene in the ground battle over an area stretching for hundreds of miles, where manœuvrability, speed and in particular the ability to use cover, become the major virtues.

Although many experts consider that it is impossible to conceive of limited atomic war, for it will degenerate rapidly into total atomic war, many British writers seem to think that such a conflict, limited both in area and in the nature of weapons, could last longer than is at present believed. Consequently the role of tactical air power in such a conflict will be considerable. Apart from such missions as liaison, observation, reconnaissance, transport or rescue, targets on the battlefield (particularly mobile, which are the most numerous and dangerous) cannot be attacked effectively other than by manned aircraft. In leaving a number of fixed targets to the Army's missile forces, the British consider that the fighter-bomber which was so effective during the last war is still far from being finished. That is why, after watching for a long time, with a certain indifference, the efforts of NATO to promote a tactical aircraft capable of operating without a modern base amid the dangers of an atomic battlefield, one sees them today taking an interest in this formula and preparing the Hawker P.1127 as successor to the Italian Fiat G.91.

There remains an important sector of operations in a future war where it appears that the aircraft will withstand the growing competition from missiles for a considerable time to come. This is in the domain of naval warfare, and the place the sea has always held is well known in the considerations of the large island that is Britain. Many people believe that the aircraft carrier will play, particularly in the open areas of the oceans, a major role in a future conflict. The efforts made to modernize the Fleet Air Arm have been remarkable, and with the Vickers Supermarine *Scimitar* as a fighter, the de Havilland *Sea Vixen* as interceptor and strike aircraft, and finally the Blackburn NA.39 twin-engined transonic low-level strike aircraft, which is perhaps the one in the world best adapted to its function, it can look to the future with a certain confidence.

Whatever one may think, however, of the aircraft carrier as a combat arm, there is at least one role in which it remains particularly effective: namely, as a mobile air base. In the troubled days in which we live, it can rapidly transport and bring into action, off territory which is either badly equipped for land-based operations or even hostile, an atomic air force capable by its mere presence of extinguishing "brush fires" which might otherwise develop into serious outbreaks.

*

This brings us to the requirement of mobility, a necessity in relation to Britain's world-wide responsibilities, which always remains one of the key words of her military strategy. From the point of view of the RAF this requirement is translated into fact by the maintenance in service of a fleet of military transport aircraft, both tactical and strategic, capable of rapidly handling any difficult situations which might arise, either in the European theatre or at any point whatsoever in the Commonwealth.

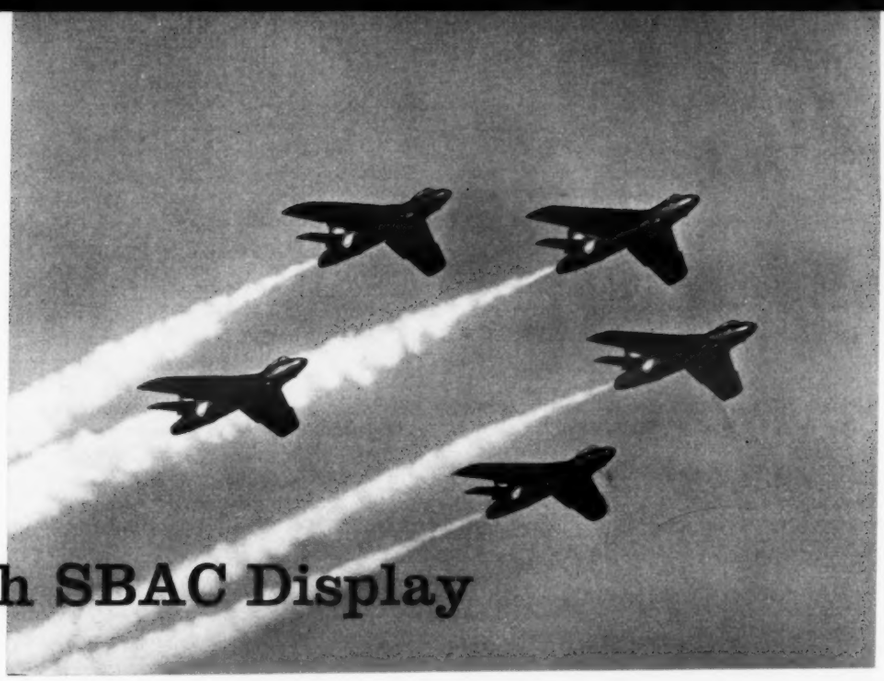
Certainly we should not build up any false illusions. The memory of Suez is still too fresh for us to be unaware of the deficiencies in military air transport, inasmuch as it does not work as it did during the last war on the basis of thousands and thousands of aircraft. However, when Transport Command is completely re-equipped with the *Comet 2s* and *Britannia 253s* which are on order and of which it has already received a number, it will be capable, we are told, of "transporting to the Middle East between dawn and dusk, 2,000 fully-equipped troops". That is a possibility worthy of consideration and clearly indicates Britain's desire to remain a great Power capable of making her voice heard wherever she considers it necessary.

The following are the principles determining the military and in particular the aerial strategy of Great Britain:

To continue to play a leading role in NATO and to prove to her American cousins that she remains their number one European ally because she has given them bases for their bombers—and also for their fighters; because she is capable of constructing the atomic bomb and developing airframes, engines and equipment equal in performance to those from America; because also Britain, as an island, still remains easy to defend—not from destruction, but from occupation. Moreover, to maintain a position in an unstable world which offers more opportunities than are generally realized to peoples who are courageous and persevering and who retain confidence in their basic qualities.

But will Britain be able to support such a policy? Will she be able to maintain her isolation from continental Europe? In the face of the formidable industrial power of the United States, is there any other solution than a union of all the free peoples of Western Europe if the latter wish to be able to compete on grounds of quality and price with trans-Atlantic products?

Only the future can give the answer to such a serious and important question. At all events, one can only admire a nation which, over the winds and seas, always carries its flag high and courageously maintains its great traditions.



Impressions of the Twentieth SBAC Display

Brilliant sunshine welcomed visitors to the Society of British Aircraft Constructors' 1959 Display, which was held at the Royal Aircraft Establishment's airfield at Farnborough from September 7th to 13th. But, in spite of the unusually kindly weather—and the further rise in the export figures for the first six months of 1959—the forecast was "outlook unsettled". The results of the 1957 White Paper and the effects of the vast sales of American turbine-powered aircraft in recent years could not be overlooked, for they determined both the number and the choice of the models on show: the scene was dominated by manned missile platforms and, above all, by airliners for purses of all sizes. The list of exhibitors, too, showed that the industry as a whole had undergone fundamental structural changes. No fewer than thirteen amalgamations of leading British manufacturers had brought to the catalogue new double names which cropped up again and again in the most diverse fields of aircraft production and even in sectors which had nothing to do with aviation.

The masterly flight displays and the close formation demonstrations of Air Force and Navy units almost made the observer forget that the British aviation industry has had to dismiss workers at the rate of about 10,000 a year since early 1957. Pilots vied with each other in bringing out the qualities of their aircraft and showing visitors the entire range of fixed- and rotary-wing models, hovercraft and VTOL equipment, intoxicating them with the roar of engines and perpetual movement. All this could not, however, conceal the fact that the changeover to new development programmes had affected this year's display. It will be some years before the outcome of these efforts becomes visible to the general public.

*

Nevertheless, no fewer than ten aircraft models were making their Farnborough debut, including helicopters and flying test beds of advanced design. Above all, however, the 8,000 visitors from abroad were surprised by the development and production programmes for jet engines which, if stipulated delivery periods are maintained, should bring a new lease of life to the engine industry. Particularly worthy of mention are the Bristol Siddeley BE.58 ducted fan engine (14,500 lb. thrust at a weight of only 2,600 lb. and a specific fuel consumption of 0.57 lb./lb./hr), the Rolls-Royce RB.141 by-pass engine (provisional thrust 14,300 lb.), the Rolls-Royce RB.145 light engine, a development of the RB.108 with 2,750 lb. dry thrust, the RB.146 etc. With the limited space available in this brief survey it is impossible to give a detailed account of new developments in the British engine industry; but the next issue of *Interavia* review will contain a comprehensive analysis of engine development in Great Britain.

As well as several mockups of models under development, including a full-scale mockup of the front fuselage of the Avro 748, the following new designs were on show:

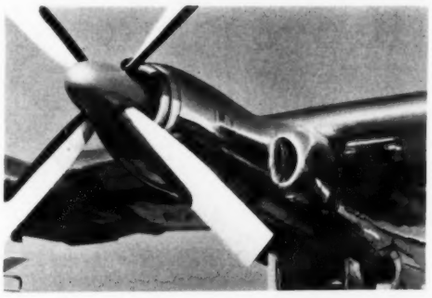
- Saunders-Roe SR.N1 *Hovercraft* (with Alvis Leonides 523/5 540 h.p. piston engine).
- Short SC.1 experimental VTOL aircraft (five Rolls-Royce RB.108 jet engines).

Farnborough

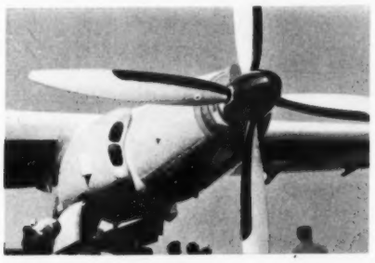
- De Havilland *Comet 4 B* medium-range jet transport with thrust reversers on the two outer engines (four Rolls-Royce *Avon RA.29* of 10,500 lb. thrust each).
- Vickers *Vanguard* short- to medium-range turboprop transport (four Rolls-Royce *Tyne RTy.1*, each of 4,985 e.h.p.).
- Armstrong Whitworth *Argosy* freight and passenger transport (four Rolls-Royce *Dart RDa. 7/2* propeller turbines, each of 2,100 h.p.).
- Handley Page *Dart Herald* feeder aircraft (two Rolls-Royce *Dart RDa.7/2* propeller turbines).
- Avro *Vulcan B.Mk.2* jet bomber (four Bristol Siddeley *Olympus 201* jet engines, each of 17,000 lb. thrust).
- Folland two-seat transonic *Gnat Trainer* (Bristol Siddeley *Orpheus Mk.100* of 4,230 lb. thrust).
- English Electric P.11 supersonic trainer (two Rolls-Royce *Avons* plus afterburners).
- Westland *Westminster* heavy helicopter, prototype for a combined crane and transport helicopter for guided weapons, military equipment, and industrial applications (two Napier *Eland 229/229A* turboshaft engines).

Fairey *Rotodyne* (Napier *Eland N.E1.3*).

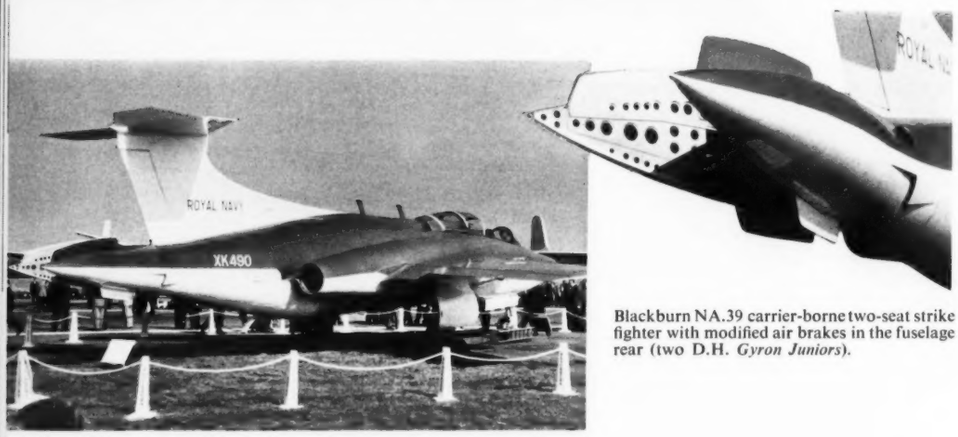
Under the wing of the Avro *Vulcan B Mk.2* V-bomber. The prototype shown at Farnborough did not yet have the fuselage rear thickened to meet the area rule.



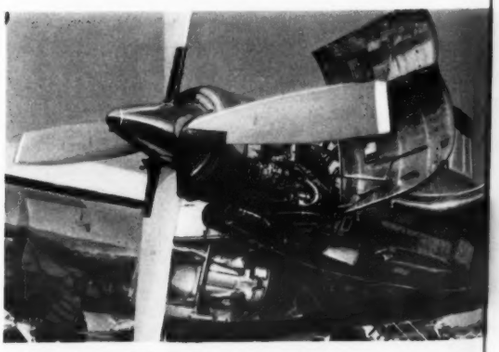
Armstrong Whitworth *Argosy* (Rolls-Royce *Dart RDa.7/2*).



Handley Page *Dart Herald* (Rolls-Royce *Dart RDa.7/2*).

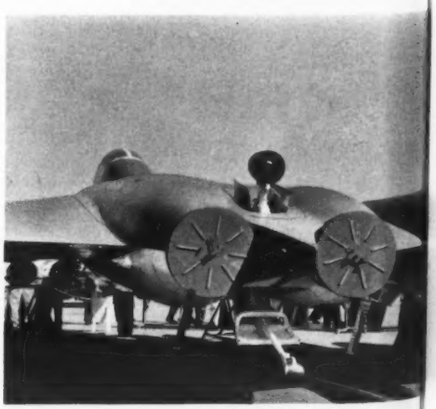


Blackburn NA.39 carrier-borne two-seat strike fighter with modified air brakes in the fuselage rear (two D.H. *Gyron Juniors*).



Vickers *Vanguard* (Rolls-Royce *Tyne RTy.1*).

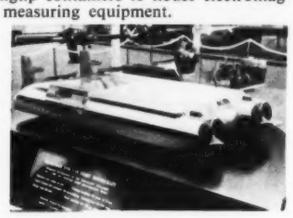
The English Electric P.11 supersonic trainer, a variant of the P.1B; military designation *Lightning* T.4 (two Rolls-Royce *Avons* with afterburners).



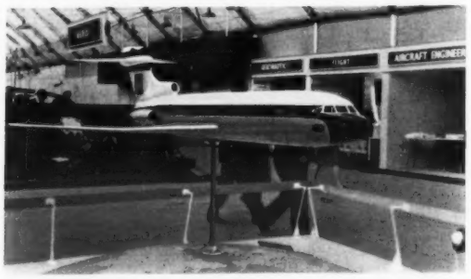
View of the centre fuselage of the carrier-borne de Havilland *Sea Vixen*. *Left:* On top of the fuselage between the two Avon jet pipes is the emergency ram air generator; beneath, the arrester hook. *Right:* Rocket launchers for fourteen unguided air-to-air missiles, in lowered position.

The de Havilland *Comet 4B* for 84 to 102 passengers in BEA's new colours.

Scottish Aviation *Twin Pioneer* with increased wing span and additional wingtip containers to house electromagnetic geophysical measuring equipment.



Top left: Projected version of the Westland *Westminster* for transporting suspendable loads or passenger cabins. *Top right:* Saro's project for a 400-ton passenger and car ferry on the *Hovercraft* principle. *Bottom:* Airco D.H.121 with three R.-R RB.163.



The Saunders-Roe SR.N1 *Hovercraft*, designed and built by the constructor under contract to National Research and Development Corporation in less than eight months, began flight tests in June this year, and its appearance at Farnborough left a lasting impression. Demonstrations of hovering over the concrete runway and over a grass surface gave proof of the hovercraft's mobility and of the safety of a transport platform which skims over the ground on an air cushion. Astonished onlookers saw 20 troops jump aboard and float away only a few inches above the ground, as if on a magic carpet. A noteworthy performance, when it is remembered that the rotors for the air cushion are driven by a *Leonides* engine of only 540 h.p. In a letter to the *Times* Lord Brabazon of Tara pointed to many possible applications of the hovercraft principle: passenger and car ferries between Bristol and Cardiff, rapid ferrying across the English Channel, transport of cattle from the Australian interior to the coast, ferries on the larger and partially unnavigable rivers of the world.

More eventful than the *Hovercraft's* manœuvres on its shallow air cushion was the first public demonstration of the *Short SC.1* experimental VTOL aircraft on September 9th. Borne aloft by the gas jets of his four vertical Rolls-Royce RB.108s, Short test-pilot T.W. Brooke-Smith tried to direct his SC.1 from a take-off strip at the edge of Farnborough airfield diagonally across the grass area onto a concrete patch in front of the main stand. Freshly-mown grass and thick clouds of dust, stirred up by the gas jets from the SC.1's engines, completely hid the aircraft from view and thwarted Brooke-Smith's attempt. The SC.1 had to land with thick grass in the protective grille over the engine intakes and the air ducts to the four vertical jets completely clogged. The fact that the grass under the aircraft began to smoulder as a result of the unexpected landing, recalls the oft-expressed recommendation that it is more advisable for jet-powered VTOL aircraft to operate from concrete runways.

As for the flight displays of the more conventional aircraft, these, as is always the case at Farnborough, were marked by well-organized planning, strict adherence to schedule and the superb skill of the pilots. The organizers never fail to do the impossible in bringing together a varied assortment of aircraft of widely divergent speed and performance classes in a continuous and coherent stream.

The famous RAF No. 111 Squadron (Treble One), flying Hawker *Hunter F.6s*, led the flight demonstrations, as usual, with a masterly display of aerobatics in formation, and five Royal Navy pilots on *Scimitars* closed them with daredevil feats in dashing style.

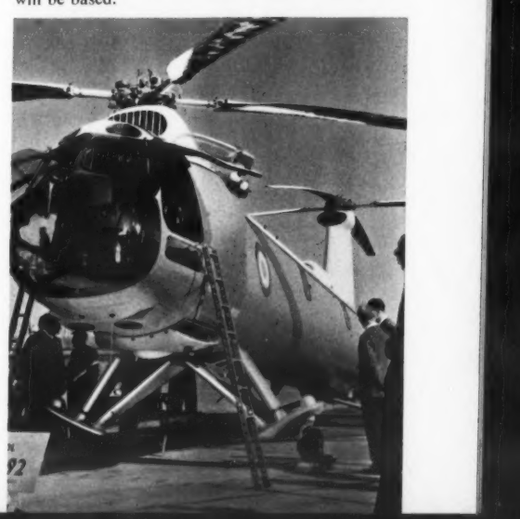
The parade of transport aircraft began with the de Havilland *Comet 4B* in BEA's new red, white and black livery. A landing at maximum permissible weight with the use of the thrust reversers on the two outboard engines, showed more clearly than any figures that this large medium-range transport is suitable even for medium-sized airports. The Fairey *Rotodyne* demonstrated its full speed range at full payload in a series of relatively fast fly-pasts and the transition to hovering flight at a steep angle of incidence prior to vertical landing. The prototype shown at Farnborough serves as model for the production version, which will be powered by Rolls-

First prototype of the Westland *Westminster* heavy helicopter with rotor and transmission by Sikorsky.

Production model of the Westland *Wessex* all-weather helicopter for the Royal Navy.

Saunders-Roe P.531 with D.H. 1000 *Gnome* gas turbine (top) and Blackburn A.129 (bottom).

Front view of the fourth Bristol 192 prototype, the model on which the RAF production version will be based.



Blackburn NA.39: Large weapons bay with rotating doors. Behind is the black antenna housing of Doppler radar.

A masterly demonstration of two *Hunting Jet Provost T.1s* by pilots of the Central Flying School.

A Folland *Gnat Trainer* going into a 6 g curve at low level.

A Handley Page *Dart Herald* flying on one engine.

Royce *Tynes* and whose future has been assured by a substantial Ministry of Supply development contract granted on the eve of the 20th SBAC Display. This will enable Fairey to execute the BEA order for at least six *Rotodynes*, the order which New York Airways intends to place, and further contracts from the British Army.

But these were by no means all the aircraft offered at Farnborough. The Armstrong Whitworth *Argosy*, the Handley Page *Dart Herald* and the Vickers *Vanguard* fill the remaining roles which tomorrow's airliners will be called upon to play: mixed freight and passenger transport over short to medium stages; passenger feeder services to the more important air traffic centres and intercity traffic in countries of large area; economical passenger transport over short and medium stages with high passenger volume. The *Vanguard*, a typical representative of the second generation of turboprops, promises such a drastic reduction in direct operating costs that tourist tariffs could be cut by almost half even with a load factor of only 65 percent. The same manufacturer's four-jet VC.10, on which work is proceeding at high pressure, is by no means a competitor to the *Vanguard*, as it has more than double the take-off weight, is designed for the high-speed transport of 150 passengers over intercontinental distances and will not be ready to go into service with BOAC until 1963.

This year's display of models gives a glimpse into the immediate future of British civil aircraft production. Apart from the Airco D.H.121 (three Rolls-Royce RB.163s) and the four-jet Vickers VC.10, two new trends can be distinguished:

1. Successors to the DC-3, such as the Avro 748 (two Rolls-Royce *Darts*) and the de Havilland D.H.123 (two D.H.P.1000 *Gnomes*);
2. Short-range jet transports, such as the Bristol 205 (for 60 to 70 passengers) and the Hunting

"Treble One" —the sixteen *Hunters* of No.111 Squadron RAF.

Short take-off of the Avro *Vulcan B.Mk.2*. With a deafening roar from its four Bristol Siddeley *Olympus* engines the bomber, whose delta wings measure over 100 feet across, climbed to a height of 3,000 feet to streak past the stands at low level one minute later.

Westland/Saunders-Roe helicopter parade.

Vickers *Vanguard*.

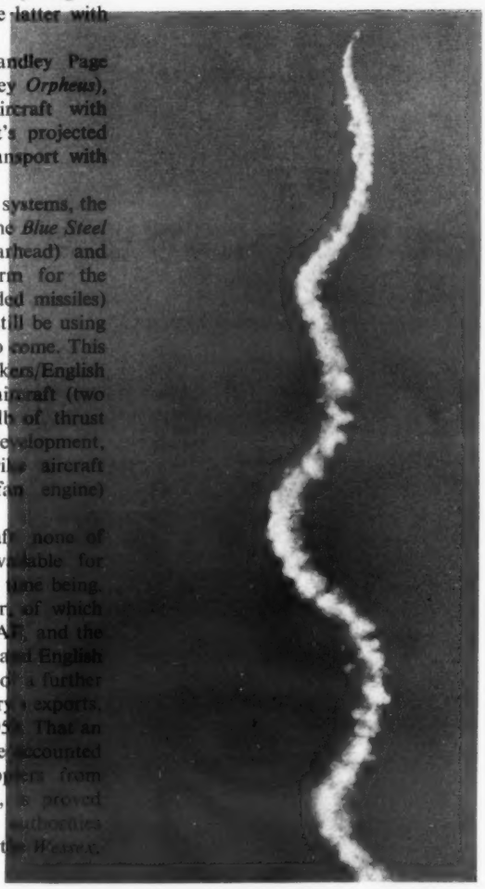
A *Bloodhound* anti-aircraft missile slung beneath the Bristol 192.

H.107 (for 40 to 48 passengers), the former with two or four Bristol Siddeley engines installed at the fuselage rear, the latter with two Bristol Siddeley *Orpheus*.

Also worthy of note is the Handley Page H.P.113 project (two Bristol Siddeley *Orpheus*), a long-range twin-jet business aircraft with boundary layer control, and Short's projected SC.7 STOL light multipurpose transport with 1½-ton payload.

In the military sector two weapons systems, the Avro *Vulcan B.Mk.2* (platform for the *Blue Steel* stand-off bomb with hydrogen warhead) and the English Electric P.1B (platform for the *Firestreak* and other air-to-air guided missiles) are a clear sign that the RAF will still be using the manned aircraft for some time to come. This trend is also underlined by the Vickers/English Electric TSR.2 tactical supersonic aircraft (two Bristol *Olympus*, each with 33,000 lb of thrust with reheat), which is now under development, and a Hawker P.1127 VTOL strike aircraft (Bristol Siddeley BE.58 ducted fan engine) designed to NATO specifications.

As for exports of military aircraft, none of the models mentioned will be available for delivery to foreign air forces for the time being. The two-seat *Gnat Trainer*, however, of which 14 are under construction for the RAF, and the latest versions of the Hawker *Hunter* and English Electric *Canberra*, hold out promise of a further increase in the British aircraft industry's exports, estimated at over £175 million for 1959. That an important share of this figure will be accounted for by the turbine-powered helicopters from Westland/Saunders-Roe and Bristol, is proved by the interest shown by military authorities of other countries in the *Westminster*, the Wessex, the Saro P.531, the Bristol 192, etc.



Mobile as a small rotorcraft. Later the Westland *Westminster* raised a bridge of light construction and laid it accurately on its foundations.

Slow fly-past of a Royal Navy *Scimitar*, showing special hook for a *Dart* target tow-line.

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No attempt has been made in this limited space to report on the ever-increasing volume of equipment on show in the large marquee; readers are referred to the article "Telecommunications and Electronics at Farnborough" (p.1244). The guided missiles, which were originally the cause of all the commotion and upheaval in the British aircraft industry, took up relatively little space even this year, although details of the main weapons systems were issued for the first time. Another article in this issue summarizes the new missiles in the 20th SBAC Display. The further development of the *Blue Streak* LRBM, the *Blue Steel* stand-off bomb and new generations of automatic antiaircraft weapons and longer range air-to-air missiles is awaited with interest.

Somewhat embarrassed, Interavia must congratulate Hawker test pilot Bill Bedford, who appears to have succeeded in spinning the Hunter 66 skywards. This is the way the printers decided to mount the picture after learning of the unrestricted performance of this 10-ton aircraft.

The Saunders-Roe *Hovercraft* in an "assault" role with twenty troops.

What's in the Air?

Sir Aubrey Burke (left), Managing Director of Airco, and Anthony Milward, Chief Executive of British European Airways, after signing the contract for 24 three-jet D.H.121s with spares, to the total value of £28 million.

The Australian Millicer Air Tourer Mk. 1 *sports and touring two-seater is to be produced in quantity by Pacific & Western Aviation after type approval. The low-wing aircraft, of wooden construction, with side-by-side seats, will be powered by a Continental C90.*

● **Continental Airlines** has been seeking CAB permission to operate non-stop Boeing 707-124B services to Honolulu from Chicago, Denver, Kansas City, Los Angeles and San Francisco. Continental proposes to offer economy coach fares at rates one third below present coach fares; initial schedules propose 33 round-trip flights weekly between Hawaii and the mainland, with a 32 first class and 104 economy coach class seating configuration.

● **Qantas Empire Airways and British Overseas Airways Corporation** have announced joint services on the Kangaroo route (London–Middle East–Australia). Qantas will introduce the Boeing 707-138 into service on this route on October 15th; BOAC will inaugurate *Comet 4* services on November 4th. The two carriers will offer eight services weekly. Flying time will be reduced to 33 hours from present Qantas time of 63 hours *(Super Constellations)* and BOAC's 48 hours *(Britannias)*.

● **Deutsche Lufthansa** is building a new maintenance centre at Frankfurt-Rhine/Main Airport to handle the carrier's fleet of Boeing 707-430s, scheduled for delivery in 1960. The focal point of the new facility, which is estimated to cost over DM 30 million, is a new twin-cantilever design steel and concrete hangar with dimensions 541 feet by 426.5 feet; it will be able to accommodate up to six aircraft the size of the Boeing 707 simultaneously.

● **Hamburg-Fuhlsbüttel Airport** is being developed to take international jet traffic. Jet services have already been proposed by Pan American (three times weekly New York–London–Hamburg) and Air France (Paris–Hamburg–Tokyo).

The cost of development of Hamburg-Fuhlsbüttel is estimated at approximately DM 100 million over the next two years. The main runway will be lengthened from 7,413 feet to 10,500 feet; the second runway is to be extended from 4,810 feet to 11,876 feet. To reduce the noise disturbance, night operations at Hamburg will be restricted to a minimum.

● **The annual investment in air traffic control services** in the Federal Republic of Germany has risen from DM 20.05 million in 1953, when the Federal Government first assumed responsibility for them, to DM 35.04 million in the current year; over the same period the number of ATC employees has risen from 813 to 1,811. Significant increases in the quantity of technical aids available have also been recorded: radio stations now total 350 against 120 in 1953; there are now 16 radar stations instead of one, and nine DF stations in place of two in 1953; navigation aids, including ground beacons, have increased from 79 to 128. In 1959 the ATC services are called upon to handle some 40,000 landings and take-offs monthly, against the 12,000 monthly recorded in 1953; instrument landings in 1959 will total over 10,000 against the 810 performed in 1953.—The Federal Government is supporting the development of Eurocontrol and the replacement of the existing ATC services by a new system offering electronic air/ground and ground/air data transmission and automatic ground station equipment; the first Federal funds will be provided in 1960.

Swissair has ordered seven turbo-starters from the Industrial Products Division of the Boeing Airplane Company. They will be mounted on a Ford FK panel truck manufactured in Germany. Swissair's order, the first from a European airline, brings the number of turbo-starters on Boeing's order book up to ninety.

The Martin RB-57D for reconnaissance units of the USAF Strategic Air Command. Note the greater wing span and the modified engine nacelles in comparison with the B-57B bomber in the background. The RB-57D has also been used for high altitude tests on the Pratt & Whitney J57 jet powerplant.

● **The East German Lufthansa company** plans to introduce turboprop aircraft into service in early 1960. The aircraft will probably be Ilyushin Il-18s, and will be operated on the Berlin–Moscow service.

● **Canadair Ltd.** has been awarded a contract for airframes for two hundred Lockheed F-104G *Starfighters* (cf. *Interavia* 8/1959, page 892) for the Royal Canadian Air Force. The announcement of a $80 million contract awarded to Orenda Engines Ltd. for production of the General Electric J79 for the F-104G was made in July. Still to come is a contract for the fire control system, which will be manufactured as far as possible under licence in Canada. The total value of the 200 F-104Gs, excluding weapons, will be about $420 million. Orenda and Canadair may not spend more than the contract price, but will get $1 in $3 of any money saved from the price bid. Avro Aircraft hopes for substantial subcontracts, as its special equipment is suitable for certain key processes. De Havilland Canada will be given an opportunity to bid on weapons for the F-104, when these are selected. Under subcontract to Lockheed, Canadair will also produce some 30 percent of 66 additional *Starfighter* airframes for the Federal German Government. The Canadair

The Vertol YHC-1A turbine-powered helicopter (two General Electric T58) for the U.S. Army flew for the first time at the end of August. It belongs to the Vertol 107 family, whose prototype was recently shown on a ten-week 2,500-mile tour of northern Europe. The U.S. Army has ordered a pre-production series of YHC-1As for operational trials.

The Cessna CH-1C four-seat helicopter has received FAA certification for an all-up weight of 3,100 lb. Powered by a 270 h.p. Continental engine, it has cruising speeds between 80 and 105 knots and a maximum rate of climb of 1,030 f.p.m. Length 42.7 ft., height 11.4 ft., rotor diameter 35 ft.

contract will not bring any increase in employment, since other defence contracts such as the CL-28 *Argus* anti-submarine aircraft are being phased out. The Orenda contract will mean about 3,000 jobs in the Malton area.—In addition to the two hundred F-104Gs, the Canadian Government is buying fourteen two-seat *Starfighters* from Lockheed for training purposes.

● **Lockheed Aircraft Corporation** delivered the final T-33 jet trainer to the U.S. Air Force at the end of August. Since 1948 Lockheed has manufactured 5,691 T-33s to a total value of $570 million; the jet trainer is in service with 26 nations.

● **The Hawker Siddeley Group's Aviation Division** has been awarded a formal contract by the British Ministry of Supply for 20 Armstrong Whitworth AW.660s (a military version of the *Argosy*) to be used as tactical freighters by RAF Transport Command.

● **Claude Grahame-White**, pioneer aviator, aeronautical engineer and author, died in Nice in the middle of August. Grahame-White was the first Englishman to be granted a certificate of proficiency as an aviator (1909) and also launched the first British flying school (1909). He was the first English pilot to carry mail by air, and in 1910 he won the Gordon Bennett trophy in the United States in a Blériot monoplane at a speed of over 60 m.p.h. He was founder of the Grahame-White Aviation Company, today known as the Grahame-White Company. He was the author of many works on aviation subjects.

● **Sud-Aviation's order book** lists the following deliveries of SE.210 *Caravelles*: one for Varig and the sixth for Air France in September; the fifth for SAS Scandinavian Airlines System in October; one each to Air France and SAS in November; a second *Caravelle* for Varig and an eighth for Air France in December. The total number of *Caravelles* delivered by the end of the year will thus be brought to sixteen. All contractual delivery dates are being maintained, although some aircraft are being delivered ahead of schedule.—Up to the beginning of August, the nine *Caravelles* in service with Air France and SAS had logged a total of 6,500 hours in commercial operations.

● **The Dassault Mirage IV** will not be powered with the Pratt & Whitney J75 jet engine, but with an improved SNECMA *Atar 9*. This decision will not affect United Aircraft's participation in SNECMA capital, and the American company will continue to provide specialized technical assistance on the maintenance of the Pratt & Whitney powerplants; SNECMA has signed a two-year contract with Air France for overhaul of the J75s powering the carrier's Boeing 707s.

● **Bölkow-Entwicklungen KG,** of Ottobrunn, near Munich, is establishing a special new Plastics Department to handle basic research and employment studies in the field of reinforced plastics.

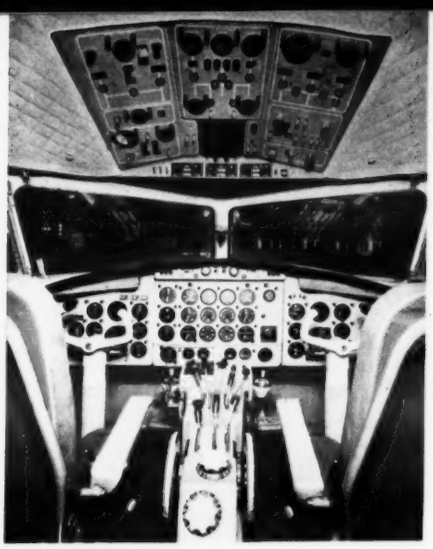
● **The two-seat Folland Fo. 144 Gnat Trainer**, of which the Royal Air Force has ordered fourteen for evaluation purposes, began flight tests on September 1st. Of light construction, the trainer is powered by a Bristol Orpheus BOr.4 jet engine 4,230 lb. thrust; technical data are as follows: wing span 24 ft.; length 30 ft. 9 in.; height 9 ft. 7.5 in.; wing area 175 sq.ft.; aspect ratio 3.29; 40° sweep-back at 25 percent of chord; weight equipped 5,070 lb.; all-up weight normally 7,435 lb. or 8,560 lb. maximum with external fuel tanks. Maximum speed around Mach 0.95+; take-off distance 1,560 ft.; landing distance with braking parachute 1,410 ft.; endurance with external fuel tanks 2 hours 15 minutes.

● **The Napier Gazelle** (Westland *Wessex* and Bristol 192) is the first helicopter gas turbine to receive Ministry of Supply 150-hour helicopter type approval, at 1,650 s.h.p.

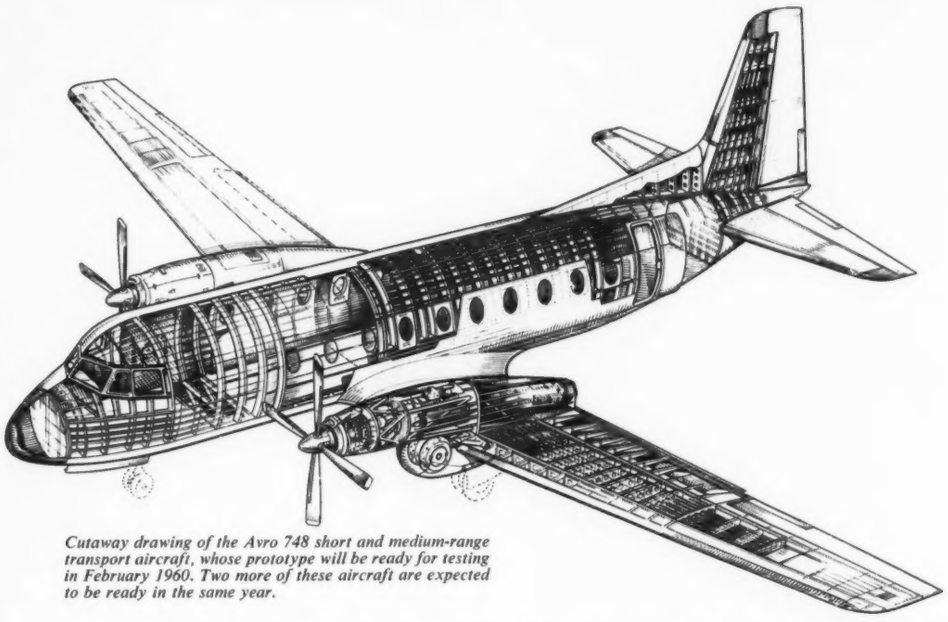
French OMERA 31 aerial camera; for description see text.

Five de Havilland Canada DHC-4 Caribous *(two Pratt & Whitney R-2000) have so far been built for the U.S. Army. This STOL aircraft can transport 29 troops with equipment or two jeeps, which can be driven into the cabin through the 73.5 × 75 in. loading hatch. Maximum range with a 3-ton payload is 1,000 st.m.*

The first powered flight of the North American X-15 research aircraft should have taken place by the time this issue appears, after being postponed several times due to technical difficulties. The picture shows the X-15 under the Boeing B-52 parent aircraft. Between the X-15 and the engine nacelles can be seen the escort aircraft, a North American F-100 Super Sabre.



Projected design for the passenger cabin and flight deck of the Avro 748. The aircraft can be equipped for 36, 40 or 44 passengers, as a business aircraft, as a combined passenger/freight transport, or for freight only.



Cutaway drawing of the Avro 748 short and medium-range transport aircraft, whose prototype will be ready for testing in February 1960. Two more of these aircraft are expected to be ready in the same year.

● **The General Electric T58 turboshaft engine** has received FAA certification for use in commercial helicopters. Designated CT58-100-1, it is guaranteed at 1,050 s.h.p. for take-off and 900 s.h.p. continuous rating; weight 271 lb.; specific fuel consumption at 1,050 s.h.p., 0.64 lb/hp/h and 0.67 lb/hp/h at 900 s.h.p.

● **Details of the J85-5 and J85-7 (missile) engines** are as follows: The GE J85-5 delivers 3,850 lb. of thrust with reheat or 2,500 lb. dry and weighs 525 lb.; the GE J85-7 delivers 2,450 lb. of thrust dry and weighs 325 lb. The J85-5's dimensions are: length (with afterburner) 104 in.; max. diameter 21 in. Dimensions of the J85-7: length 39.3 in.; max. diameter 17 in.

● **The Federal Aviation Agency** delivered a type certificate for the Douglas DC-8 jet airliner on August 31st, 1959.

● **For flight testing the de Havilland Gyron Junior D.Gy.J.10** (a version of this jet engine with afterburner will power the Bristol T.188 research aircraft), a Gloster *Javelin Mk.1* has been modified by D. Napier & Son Ltd. The aircraft has been fitted with two D.Gy.J.10 engines with afterburner units and will be test flown from the de Havilland Engine Company's experimental establishment at Hatfield later this year. The *Gyron Junior D.Gy.J.10* develops 10,000 lb. of thrust at sea level, static and without reheat; thrust with reheat is 14,000 lb.—Dimensions: overall diameter (compressor and turbine) 32.3 in.; overall length from compressor inlet face to turbine exhaust flange 70 in.; overall length from compressor inlet to afterburner exhaust 191 in.; overall diameter (reheat section) 36 in.—The D.Gy.J. 10 has an axial compressor with a moderate number of stages; inlet guide vanes and first row of stator blades are of variable incidence. Blade incidence automatically varies in response to changes in selected engine operating parameters.—Short-length combustion chamber with fully annular flame tube, supplied with fuel by 13 upstream injectors.— Multi-stage axial turbine.

These three Convair 880s, powered by four General Electric CJ-805-3s, have been undergoing flight trials since August 10th. Flights to obtain U.S. Federal Aviation Agency certification began in September, and first deliveries, to Trans World Airlines, are planned for next month.

● **Société OMERA,** of Argenteuil, France, has developed, in cooperation with the Direction Technique et Industrielle, a new medium-sized aerial camera, the OMERA 31, illustrated in these pages. The camera, which is already in service on all aircraft of the 33rd Reconnaissance Squadron of the Armée de l'Air, is 240 mm broad, 173 mm high and 249 mm. deep; size of pictures 114×114 mm; magazine for 250 frames; exposure times 1/200 to 1/2400 sec; focal lengths 100, 200, 300 and 600 mm; rate of transport of film 7 to 230 mm per sec.

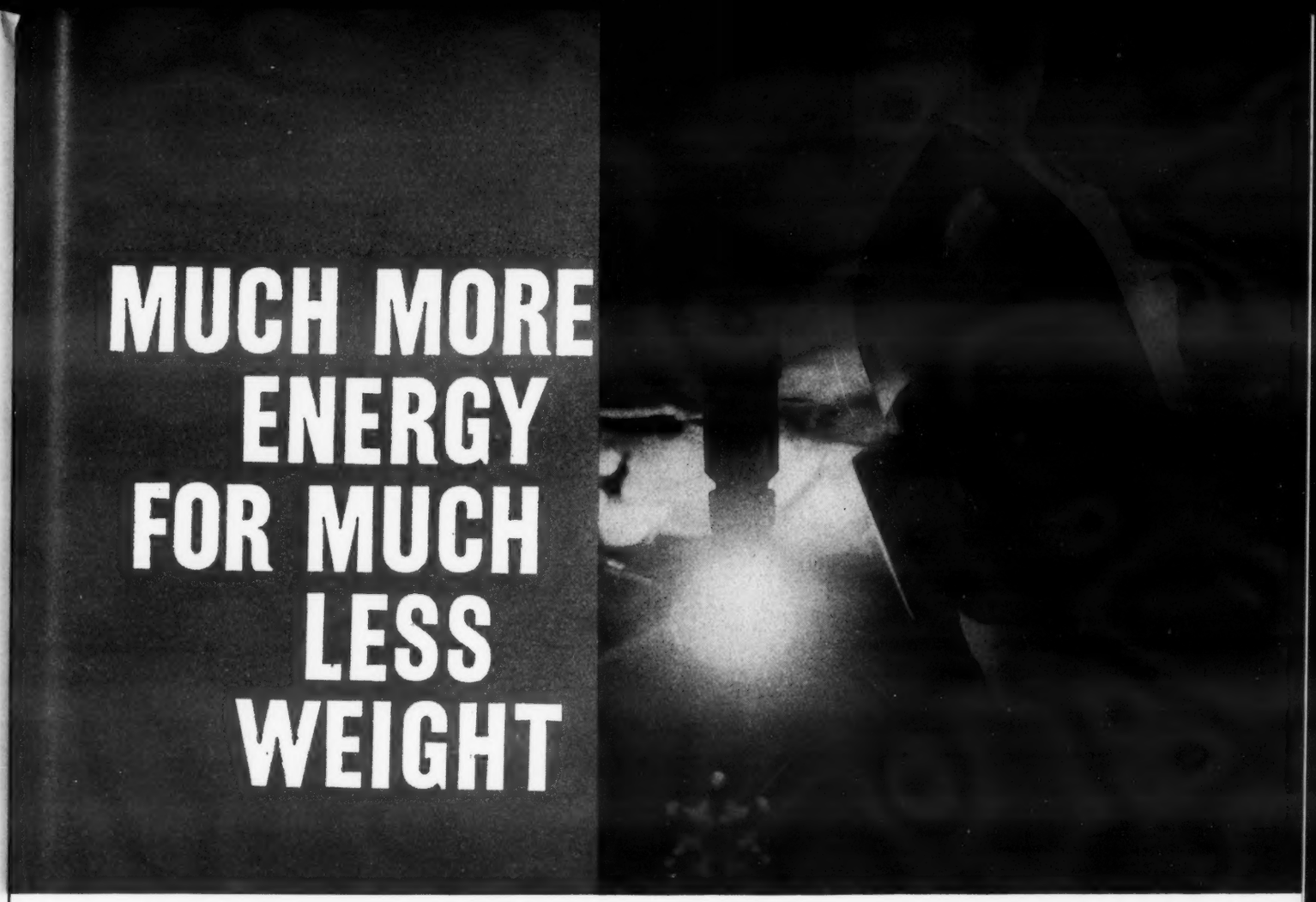
● **The Bristol T.188 research aircraft,** which is largely of steel and ceramic construction, is powered by de Havilland *Gyron Junior D.Gy.J.10* jet engines, according to agency reports from London. The T.188 is designed for a speed range between Mach 2.5 and Mach 3 and will be used primarily for investigations of flying behaviour and control, and for research on the endurance of structural materials at these speeds.

● **The Sikorsky S-60 twin-engine crane helicopter** was recently turned over to the U.S. Army under a contract calling for several weeks' evaluation of the crane helicopter concept. The handing-over ceremony took place at Fort Rucker, Alabama, and on this occasion the S-60 made its first public flight with a detachable pod for carrying passengers. It was disclosed that through the use of a special cushioned device between the cabin and the airframe proper, it is possible to virtually eliminate vibration in the cabin. It was also announced that Sikorsky can build a twin-turbine powered crane with an eight-ton payload and growth potential to 12 tons, and that this new aircraft could fly within one year.

● **Two Aerojet-General Model 15NS-250 solid fuel standby rocket motors** can be fitted to both the D50B and G50 versions of the Beechcraft *Twin-Bonanza*. The motors, which have been approved by the Federal Aviation Agency, are available as factory-installed equipment or in kit form through Beechcraft distributors and dealers.—Each unit weighs 42 lb. and delivers 250 lb. thrust for a duration of 15 seconds.—As used in the Model G50, the two JATO units will boost normal climb rates by 550 f.p.m. on take-off, and by 1,190 f.p.m. at 65 percent cruise power, both at 7,150 lb. gross weight. Performance gains on the Model D50B are: climb increase at take-off 620 f.p.m. and 1,375 f.p.m. at cruising power; both at full gross weight of 6,300 lb.

● **Texaco Inc.** has developed a new fuel for jet aircraft which will reportedly allow higher engine performance, eliminate exhaust smoke on take-off, permit increased range and extend enginelife. These improvements are considered possible in view of the fuel's extremely low "luminosity". Contrary to high luminosity fuels which give off quantities of radiant heat that can cause serious increases in jet engine temperatures without comparable power increases, the new fuel burns at higher temperatures than conventional fuels without the risk of overheating the engine.

● **NASA** has awarded a $85,188 contract to Acoustica Associates, Inc., of Plainview, N.Y., for development of a high-intensity sound device for throttling solid-propellant rockets. Acoustica engineers believe that high-intensity sound in the burning core of a solid-propellant motor can accelerate the combustion rate by as much as 250 percent, and permit the use of circular rather than star or cruciform gas ports in solid fuel motors; the additional volume made available for propellant would increase the range of a given missile system by about 10 percent. — The most important element of the system is a Levasseur whistle, which is powered by compressed gas. By increasing the sound level inside the motor by approximately 10 decibels, the burning zone in a composite propellant can be compressed to about one-fifth of its normal thickness, doubling the combustion rate and producing a more favourable specific impulse for a given propellant grain.



New Bristol Aerojet process produces gas storage vessels of great strength—high capacity—exceptionally low weight

High-pressure gas storage bottles have become an essential part of aircraft and guided missile systems. They provide a compact and efficient method of storing energy.

Bristol Aerojet, specialists in the design and manufacture of high tensile steel welded components, have developed a very advanced range of pressure vessels. Operating with great reliability at high stress levels, this new design provides unusually high energy storage capacity for exceptionally low weight.

Made of chrome molybdenum steel, the vessels are welded by the argon shielded tungsten arc process and heat treated to a minimum ultimate strength of 75 tons per sq in. All welds are examined several times during manufacture, both visually and radiographically and are subjected to the same stress as the parent material.

Bristol Aerojet pressure vessels are made in many specified shapes and range from 100 to 2,000 cu in. capacity. When compared to forged vessels they show a weight saving of at least 5 lb per 500 cu in. and as much as 50%.

Bristol Aerojet Pressure Vessels Specified For Trans-Canada Vanguards

Trans-Canada Airlines have chosen Bristol Aerojet pressure vessels for the Elliot escape chutes in their 20 Vanguards.

Other companies supplied include:

Bristol Aircraft Limited
Bristol Siddeley Engines Limited
De Havilland Aircraft of Canada Limited
De Havilland Propellers Limited
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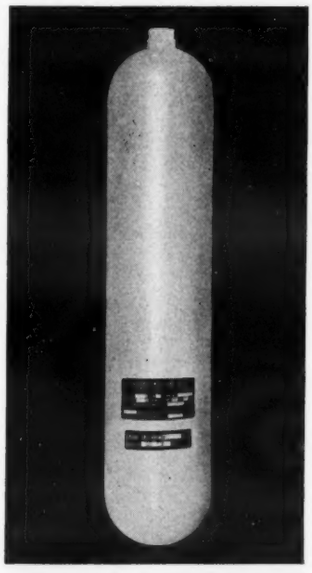
British Messier Limited
The Pyrene Co. Limited
A. V. Roe & Co. Limited
Saunders-Roe Limited
Short Bros. & Harland Limited
Vickers-Armstrongs (Aircraft) Limited

If you would like further information, about Bristol Aerojet pressure vessels or high tensile steel welded components, please write to: P. W. Lawson, Civil Sales Manager, Bristol Aerojet Limited, Banwell, Weston-Super-Mare, England. Telephone: Banwell 250.



Type 3135 Pressure Vessel
Cylindrical (525 cu in.)

Design ultimate pressure	5,000 psi
Maximum inflation pressure	2,500 psi
Free gas volume	1,470 litres
Weight	12 lb

ARB approved

Suitable for CO_2 fire extinguishers and pneumatic systems.

BRISTOL AEROJET

1279

Aro in Europe

Well, not entirely! Aro Equipment Corporation is still firmly sitting in Cleveland and Bryan, Ohio, U.S.A. But something new has been added! British Oxygen Aro Equipment has set up a new manufacturing and repair factory in Harlow, England. This is to deal with Aro products in American-built aircraft in service in European and NATO air forces and USAF; and, of course, the civil aircraft of European airlines.

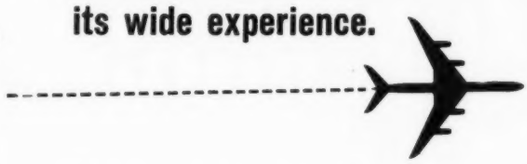
B.O.A.E. are the European associates of Aro Equipment Corporation combined with the resources of the British Oxygen Group. In this way we can offer an unrivalled service in the field of aircraft liquid and gaseous oxygen equipment and associated airborne and ground equipment. Being right on your doorstep we can supply your wants for American aircraft equipment, thus saving you time, dollars and inconvenience.

BRITISH OXYGEN ARO EQUIPMENT

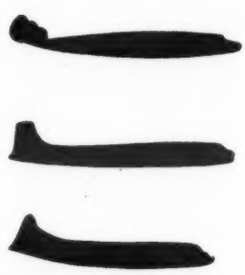
THE PINNACLES · HARLOW · ESSEX · HARLOW 26891

Suppliers to the Royal Air Force and Royal Navy, B.O.A.E. liquid oxygen equipment is being fitted to most types of modern aircraft.

KLM
the first of all existing airlines to open scheduled air services, offers you the benefit of its wide experience.



KLM, celebrating its 40th anniversary this year, operates the second longest network in the world with a fleet of modern aircraft.



SUPER CONSTELLATION scheduled services to USA, Caribbean, Peru, Far East, Japan and Australia.

DC-7C USA, Canada, Mexico, Israel, South Africa, South America.

VICKERS VISCOUNT scheduled air routes in Europe.

KLM has been the first non-U.S. airline to order DC-8 jets, and Fokker Friendship and Lockheed Electra turbo-prop planes.

The Lockheed Electra will be placed into service late this year, the DC-8 early in 1960.

GETTING READY
This is the Republic F-105 Thunderchief . . . only aircraft Weapons System ordered by the United States Air Force for Europe. This all-weather strike-attack airplane is being built for its primary mission; to serve the best interests of NATO in preventing war.
Republic's role as an aircraft designer and manufacturer is equally vital . . . to help NATO prepare for the same mission. It's a possible and practical one . . . it's the Republic Mission Plan: establishing a prime source of supply in Europe for the production of this supersonic, nuclear armed jet by various industrial firms throughout NATO countries.
Use of the F-105 throughout NATO countries gives Europe the one weapons system engineered to a specific tactical need . . . and the only aircraft which alone can accomplish the required mission. No other aircraft can do this.
REPUBLIC AVIATION
FARMINGDALE, NEW YORK, U.S.A.
Designers and Builders of the Incomparable THUNDER-CRAFT

CONTINUOUS POWER* with the AIR PARTNER

*A VITAL FACTOR IN JET STARTS

A mobile unit for starting, air-conditioning, de-icing and testing the jet airliners of today

STARTING · AIR CONDITIONING · DE-ICING

The Air Partner is a surge-free rotary screw compressor of the Lysholm type designed for starting, air conditioning and de-icing all jet and turbo-prop airliners having air turbine starters.

A SUCCESSFUL COMBINATION

Atlas Copco, the world's largest organisation devoted exclusively to the manufacture of compressed air equipment, combined aeronautical expertise with compressor know-how to produce this multi-purpose unit.

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The Air Partner delivers a continuous flow of warm, oil-free air to turn the engine over constantly thus eliminating mis-starts.

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TWO MODELS

Air Partner M-3 consists of two identical units, each including a compressor connected to a standard petrol or diesel engine, for starting, air conditioning, de-icing and checking auxiliary systems.

Air Partner M-2 consists of one rotary screw compressor connected to a standard petrol or diesel engine for starting and limited air conditioning.

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THE *Atlas Copco* AIR PARTNER

A contribution to the jet age of air travel

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C 3712R

Civil Defence of the Future

by Major General (ret.) Erich Hampe, Bonn

When the hydrogen bomb was incorporated in the arsenals of the atomic Powers, not only the general public but also many responsible planners in civil defence were assailed with a feeling of helplessness and resignation. In the United States, for example, there were those who declared that it was futile to take any protective measures. Any announcement of such projects, they maintained, was merely throwing dust in the public's eyes. It would be better and more honest to admit frankly that there is no way of preserving the populations of large cities from destruction.

Later, however, this mood of despair gave way to calmer reasoning. And today investigations into the most effective methods of civil defence are being made in all countries.

Interavia *has here given a German expert on these questions the opportunity of expressing his views because the Federal Republic, being a frontier country between West and East, is at the centre of the civil defence debate and because the German anthorities are preparing a second civil defence law to supplement the earlier law enacted in 1957. This act will deal with building protection and prescribe the various kinds of shelter which will be made obligatory in all new buildings in German cities.*

The author, Major General Erich Hampe, *was General of the Technical Troops at Army Command during World War II, was adviser on civil defence in the Federal Ministry of the Interior after the war and was responsible for the foundation of the Federal Civil Defence Institute in Bad Godesberg, which he headed until recently.*

Editors.

It is no more than a truism to state that the Allied air offensive against the German homeland during World War II was at least one of the decisive factors in the complete collapse of the German Reich.

It is a similar truism to say that recent developments in air attack weapons have greatly increased the ability to inflict strategic damage on enemy territory and will continue to increase it. Logically, therefore, the planners of the West's defences should do everything in their power to eliminate or reduce this danger. What, however, has been done?

The difficulties involved in active air defence are well known and need not be discussed here. There remains the question of passive defence measures. At the present time no country in the world provides such measures on an adequate scale, despite the fact that the latter part of World War II provided ample basic experience and sounded warnings too loud to escape notice.

In view of the vast improvements in offensive weapons there is an urgent need for a serious re-assessment of past notions and a determined effort to match civil defence to future requirements. To do this, civil defence thinking must be revolutionized in the same way as has weapons development. If this is not done, civil defence will continue to be outpaced by technical progress in the means of attack, as is now the case.

Planning of a civil defence organization for the future must be based on three principles:

a) Evaluation of earlier experience, in so far as it is still applicable to the future;

b) Assessment of the means of attack presently available;

c) Adaptation to the future development trend in these weapons.

World War II experience

As regards civil defence World War II taught two elementary lessons, which are not only still valid today but will be found even more vital in the future.

The first lesson is that in civil defence *physical protection is more important than aid given after an air attack*. As in the general prevention of accidents, the maintenance of life and limb must be given priority over the treatment of the injured. The reversal of this order would have led to a decimation of the German population in World War II if this error in thinking had not been corrected during the first three years of the war, and a successful effort had not been made to catch up in the technical protective measures which had been almost overlooked in the zealous organization of post-raid assistance services.

It is therefore doubly surprising that present-day civil defence organizers throughout the world should proudly announce how many volunteers are enrolled in their civil defence corps, how many training hours are spent and how many ambulance vehicles and equipment items are available. But, except for a very few countries, little or nothing is heard of preventive protection, although this should be the cornerstone of any civil defence structure.

This does not mean that post-raid assistance is not required. But its effectiveness is reduced unless first thought is given to actual protection. What is more, scope for assistance is in any case limited, for two reasons. In modern air raids it is no longer possible to prevent a catastrophe, and the time factor plays a decisive part in the effectiveness of the aid provided. Unless adequate forces can intervene rapidly at the danger points, the aid they bring will be of little use. But nobody knows in advance where the main points of the attack will be. The main effort must therefore be directed towards keeping the catastrophe within tolerable limits.

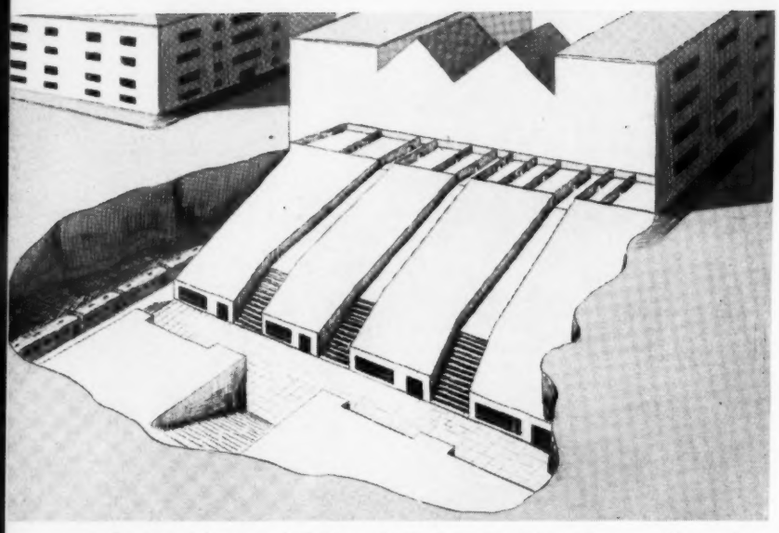
The second lesson of World War II: it was not so much the air raids on residential areas which were responsible for the German collapse as the crippling of all economic life due to the dislocation of the entire transport system. Neither coal nor milk, food nor raw materials could be moved. Power and gas stations shut down. Manufacture and the supply of goods to the civil population came to a standstill. Not until the arrival of the victors was it possible to give the German people some form of livelihood again.

As the development of weapons techniques since the end of the war has still further increased a belligerent's ability to attack the very basis of existence of enemy nations, there should be every reason to concentrate all available strength and resources on preserving the nations' viability.[1] Yet, despite the vastly greater danger today, all that is being done is to issue platonic " recommendations ".

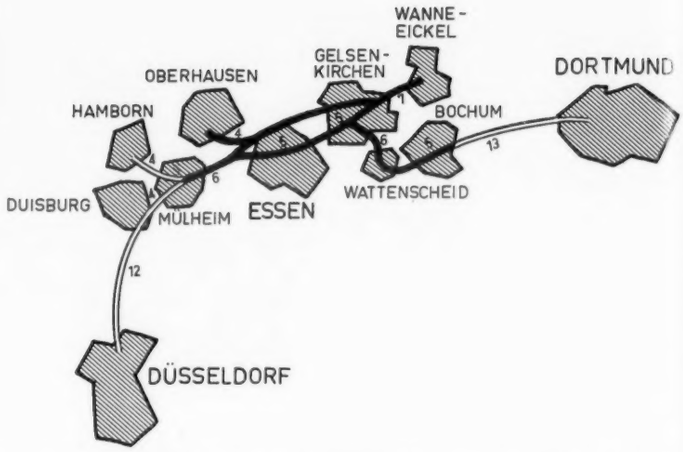
Today's weapons of attack

Anyone studying the air attack weapons of today is forced to the conclusion that all problems of civil defence have become much more difficult to solve. This means that the need to provide real protection grows even

[1] The efforts made in this direction during World War II and those which are required in the future are described by the author in his paper " Strategie der zivilen Verteidigung " — Verlag Eisenschmidt, Frankfurt/M.



Provinces below ground: Regions of very dense population, where one city runs into the next, require not only shelters with protected entrances and underground passages, but also underground railways connecting up the whole of the populated area. In other words, the population of whole towns or even provinces would disappear below ground in the event of war.



Project for an underground railway in the Rhine-Ruhr district: The heavy lines show the first development stage for an underground railway between seven cities in the Ruhr; the figures indicate distances in kilometres. In a second stage the cities of Dortmund and Düsseldorf could be added. On these latter routes the portions between the cities could perhaps run above ground, with merely the stations and tracks within the city limits underground.

more urgent, the ability to administer post-raid assistance diminishes still further, and the living conditions of the population become yet more uncertain. Basically, therefore, there is a need for still more extensive building protection, more concentrated planning to ensure that economy and transport can be maintained, and finally more and better aid services. The vastness of these tasks makes it impossible to divide defence into a civil and a military sector. Defence has become an indivisible whole.

The effects of modern weapons are not only more intensive but also more widespread than anything previously known. In recognition of this fact, the Western countries have banded together into a defence community on the military level. *Just as military defence preparations have been extended to the whole of common territory, so certain aspects of the protection of the civil population demand similar procedures.* Recommendations by the NATO Standing Committee that the population should be protected are not enough. Many of the problems involved in providing protection for the population can be solved only if the whole of the territory of the allied countries can be called upon. Warning, evacuation, supply of all kinds and the major assistance operations cannot be carried out without joint action. And just as a *joint staff has been set up for military defence preparations*, so there is an equal need for a *central civil technical and economic staff* with authority to issue instructions in all fields of joint endeavour.

On the other hand, each country will have to be responsible for the direct protection of its population, with due reference to the degree of danger to which it is exposed and to its individual resources. In fact, each city will have to take different measures, depending on local conditions. It is high time that all attempts to find one sovereign solution to the protection problem were abandoned. There are no patent solutions in civil defence, any more than in military defence or in the prevention of the dangers of everyday life. For the civil defence problem the motto " the right man in the right place " should be changed into " the right solution in the right place ".

It is therefore useless to prepare methodical calculations in which the cost of providing shelter per head of the population is simply multiplied by the number of persons to be protected. The gigantic figures which would result would merely confuse the poor citizen. This kind of estimate makes no allowance for the fact that in practice it will probably be impossible to build shelters for the whole of the population. But if, instead of applying the same yardstick to all locations, the best possible solution is sought for each city, a careful study of each case will probably lead to simpler and cheaper results.

The present article can obviously not go into the special requirements of each individual country. It can only be noted in passing that civil defence in Great Britain and the United States, for instance, will be different from that in the German Federal Republic. Requirements in Germany are determined by the country's frontier situation and demand that the land front be militarily secured and the enemy prevented from obtaining air superiority. Here, too, it will be seen how military and civil planning interlock.

However, the frontier situation has one advantage. No borderline country need fear attack by hydrogen bombs; their use would be senseless, since it would deprive the attacker of his own freedom of movement.

On the other hand, there is reason to believe that kiloton atomic weapons might be used, and the most likely form of detonation would be a surface burst. The latter not only produces all the direct effects of the atomic weapon, but also leaves residual radiation in the area attacked, which makes all normal aid virtually impossible. By laying down a suitable barrage, the attacker could in this way paralyse all the key centres vital to operational measures and the supply system for the civil population. Shipping, railways and road transport, electricity and gas supplies would

Flying ambulance: Field ambulances could be carried beneath the fuselage of giant helicopters, set down on the edge of a damaged area and fly back with injured.

be exposed to crippling blows. Once again the question arises of what protection and post-raid assistance can be given, of how the means of existence and resistance can be preserved.

It does not require any great amount of imagination to realize that present civil defence planning does not provide a satisfactory answer to these questions. Even if the large cities already had atom-proof shelters which offered a large proportion of the inhabitants a chance of survival, there would still remain the problem of radio-active contamination. This might keep the population confined to their shelters for weeks on end, and it is doubtful how long the occupants could stand such conditions if attacks were repeated and food and water began to run out. Wreckage and radio-activity would prevent any large-scale rescue operations from being carried out, as the rescue crews would themselves be endangered. Not much could be done with vehicles, either, even with armoured vehicles, as the streets would be blocked by rubble.

Survival and the capacity to continue fighting depend on the preservation of freedom of movement. Without such freedom the territory attacked is doomed. There is little point in ensuring physical survival during a raid, if economic life is so crippled that the population faces slow death. This is the danger of an inflexible, static civil defence concept.

Matching future development trends

Civil defence of the future must therefore meet many basic requirements. It must be so constituted that it not only ensures physical survival in attacks without due warning, but also maintains the freedom of movement necessary to enable the people to go on living and go on fighting. Here it must be remembered that atomic weapons would make the surface of the region attacked unfit for use. This also applies to any planned assistance measures.

These two requirements taken together—protection and freedom of movement—suggest that underground passages should be planned for cities or areas particularly liable to air attack. These passages should be so designed that they can be used in peacetime and serve, in time of war or serious international tension, as collective shelters for the population of the city centre. They would have to contain all the installations needed to support the life of the community, such as power stations, water supply systems and medical centres. Moreover, they should also have food shops, restaurants, cinemas and stocks of all kinds. In peacetime they could be used by pedestrians, who could thus escape from road traffic. Entrances and exits— with lifts—should be constructed wherever possible outside the city centre in open ground and would, of course, have to be atom-bombproof.

Whereas in peacetime the underground passages could be entered direct from the surface, covered access ways would have to be provided for wartime. For this purpose it would be necessary to make connecting doorways between the cellars of neighbouring houses and construct shafts leading down from suitable cellars into the covered access ways, which in turn would run into the passages. The access system would be used only in time of war.

As the passages are to serve as collective shelters, they should be built at an adequate depth, depending on the nature of the ground. The access ways are primarily covered escape routes and should be sufficiently protected if covered by relatively few feet of earth. Dimensions of the access ways, too, need only be large enough to allow persons to pass each other. They can therefore be built in a relatively simple form, using prefabricated parts.

Large quantities of earth would have to be removed in the construction of the main passages. This could be used to build earth walls at suitable places, which would serve a double purpose in civil defence. On the one hand they could house installations such as food stores or reserve depots; on the other they would provide some protection for neighbouring areas in the event of atomic attack, as they would deflect blast, and form a shield not only against heat and gamma rays but also against the uncontrolled spread of fire.

In areas of very dense population, such as the Rhine-Ruhr or the Rhine-Main regions in West Germany, one city runs directly into the next. Such agglomerations thus present a solidly inhabited area of considerable size. Ten million people live in the Ruhr area alone—or one fifth of the total West German population in a region equal to 4 per cent of the Federal Republic's total area. Here, in addition to the passages in the individual cities, there should also be underground railways throughout the region. The tunnels need only be big enough to allow room for the electric trains, though they would, of course, have to be widened at the stations. The latter should contain not only the installations required for operating the railway but also protected living quarters, restaurants, etc. The tracks for the two directions should be sufficiently widely spaced to prevent simultaneous blocking of both routes. The electric trains could travel at high speed and high frequency. As operations could be largely automated, the personnel required could be kept within modest limits.

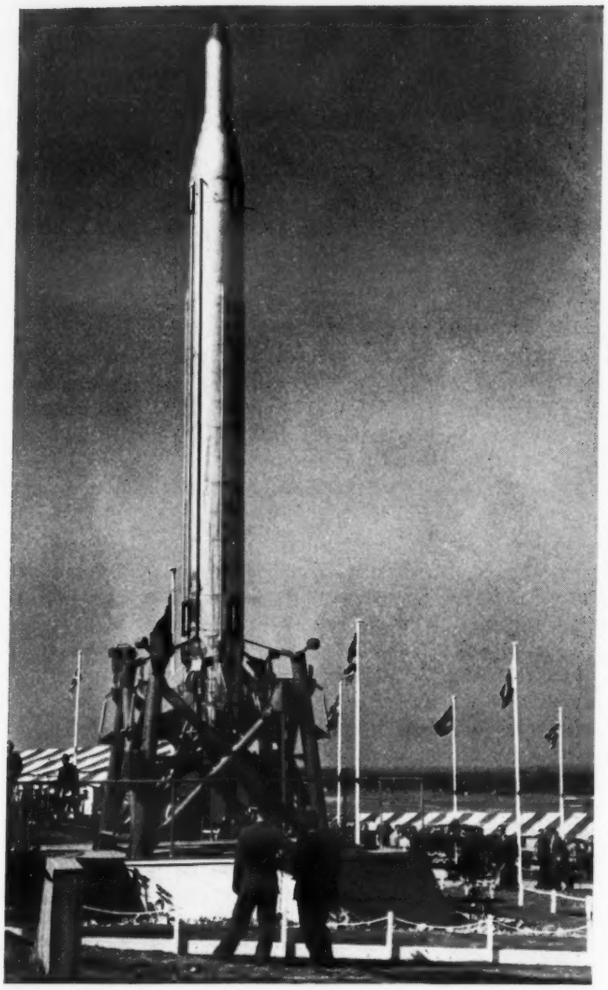
The great advantage of this plan is that it would at the same time solve an increasingly urgent peacetime problem, namely the growing traffic chaos in these over-populated regions. In wartime surface traffic would probably soon come to a standstill, and passengers and goods could then move only by underground means. In less vulnerable areas, where large-scale direct air raids are less likely than other combat operations or indirect dangers, simple shelters would suffice.

In the *planning of post-raid services*, it must be remembered that, in view of the very widespread damage caused by atomic weapons, normal assistance from the surface can be very limited in scope or even rendered entirely impossible if the ground is contaminated by radio-activity. In such cases, help can come only from another source, namely from the air. Even today the *air rescue service* plays an important role in accidents or natural disasters. But it would have to be systematically expanded to cope with the " great disaster ". Access by surface vehicle or even on foot would be virtually impossible because of the tremendous amount of rubble around the point of impact, the wider area of raging fires and the still greater area contaminated by radio-active fall-out. There would remain merely the ability to provide limited aid by air, by helicopter over short distances, and by transport aircraft over longer distances. After all, an airlift is no novelty to our generation.

The foregoing brief sketch is intended only to suggest a new, more flexible line of civil defence thinking. The big task of harmonizing these new solutions with existing preparations and of finding the right measures for each region still lies ahead. Modern engineering offers adequate possibilities in both tunnel construction and aviation. Admittedly such a programme would cost an enormous amount of time, money and labour. Yet any country which carried out the programme could feel safe from threats by a potential enemy. No effort should be considered too great if it promises to ensure peace and freedom.

" *Do-it-yourself" family shelters :* A booklet published by the United States Office of Civil and Defense Mobilization contains five plans for home shelters against radio-active fall-out. One of these shelters can be built by the home handyman.

The British Guided Missile Programme



The Saro *Black Knight* experimental rocket is expected to reach altitudes up to 1,500 miles with a second stage of new design.

A few weeks after the first *Thor* rocket squadron became operational in Great Britain the 20th SBAC Display opened its doors, and it became clear to the public that the British aircraft industry will be ready to fire its first long-range ballistic missile within a few months. This missile, which is designed to carry a hydrogen warhead over a distance of several thousand miles, is by no means merely a political weapon, but a serious project whose realization has required millions of engineer man-hours and the collaboration of several manufacturers. The launching of the first *Blue Streak* LRBM from the Woomera range in Australia at the beginning of next year will mark the opening of a new era in the history of the British aviation industry.

For some months now the engine and airframe of the 70-foot rocket, whose size and range place it between the USA's *Thor* IRBM and the now operational *Atlas* ICBM, have been undergoing static tests. As the powerful *Blue Streak* engines are run at full thrust on Rolls-Royce's test stand at Spadeadam, Cumberland, until they become red-hot, de Havilland Propellers Ltd. is testing the airframe for all it is worth at its newly erected test installations near Hatfield. Sperry has created the inertial guidance system to direct the missile onto its target with maximum accuracy. Bristol Siddeley Engines Ltd. has developed small vernier rockets (designated PR.23) delivering about 500 lb of thrust and operating on kerosene and hydrogen peroxide, which help to control the *Blue Streak* during climb and perform the last corrections to trajectory after burnout of the main engines. As G.K.C. Pardoe, of de Havilland Propellers Ltd.'s Ballistic Missile Division, informed the Commonwealth Spaceflight Symposium in London, the *Blue Streak*, using as second stage the Saunders-Roe *Black Knight*, already developed, will serve as a launching vehicle for satellites weighing between 1,000 and 2,000 lb. The addition of a third stage would enable an instrument payload to be carried to the moon.

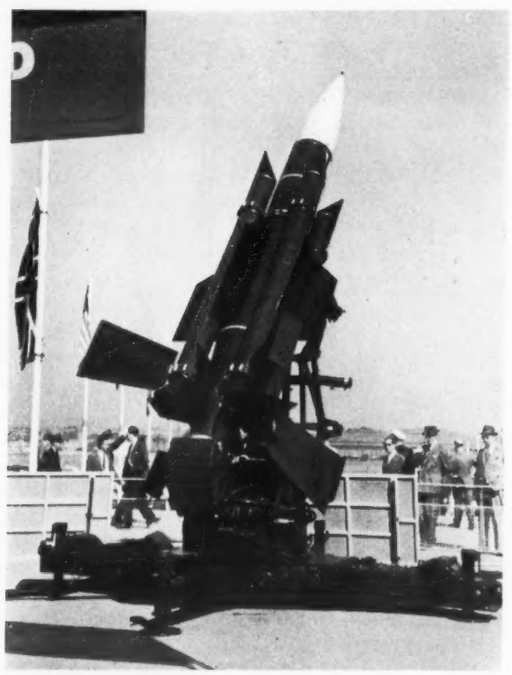
The *Black Knight* experimental rocket, on show for the first time at Farnborough with a solid fuel rocket motor as second stage, has meanwhile been rendering valuable service in the testing of nose-cones and components of the *Blue Streak* guidance system. The second stage, illustrated in these pages, will carry them to heights of over 1,500 miles. The *Black Knight* and its Bristol Siddeley *Gamma* four-chamber rocket motor will continue to play a significant role in the British space research programme.

As regards the Avro *Blue Steel* stand-off bomb, the second main British defence project, it was learnt at Farnborough that its engine consists of a de Havilland *Double Spectre D.Sp.I* double-chamber rocket motor operating on kerosene and hydrogen peroxide. The latter is a combination of a *Spectre 4* with constant thrust and a *Spectre 5* with continuously adjustable thrust; the full thrust of both combustion chambers is 16,000 lb.

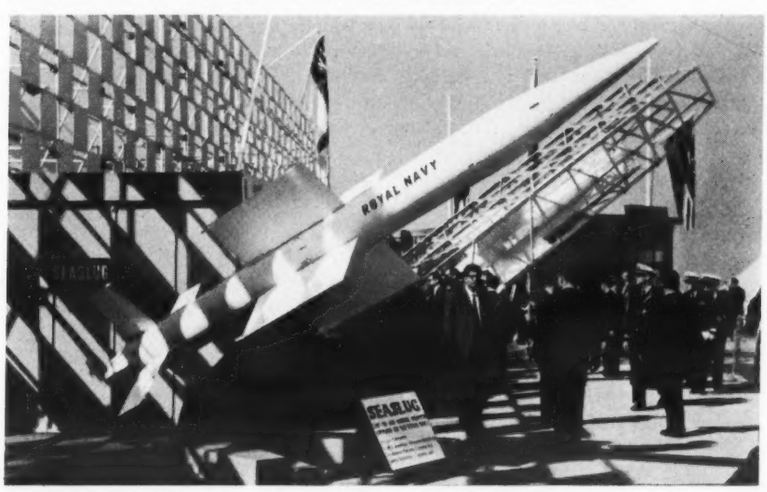
During the Farnborough Display English Electric confirmed a rumour which has been circulating for some time, to the effect that it is developing a tactical short-range missile for army support duties. The weapon is designed as a successor to the *Corporal* rockets supplied by the USA, which are maintained for the Army in Great Britain by English Electric. The new English Electric missile is mentioned in the British White Paper on Defence for 1959 as a highly mobile weapon with nuclear warhead, and is intended to be carried to the combat zone by the Armstrong-Whitworth AW.660 tactical transport ordered by the RAF, where it can be rapidly set up for operation. A solid fuel rocket motor, believed to be by Bristol Aerojet, and an English Electric inertial guidance system with a miniaturized gyro-platform, are the prerequisites for continuous operational readiness and high reliability.

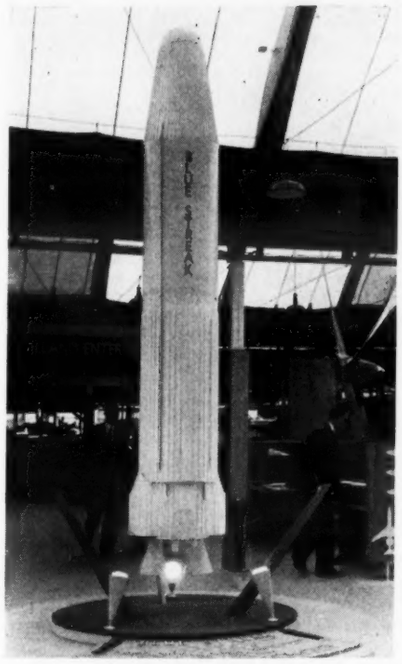
Increasingly apparent with each year that passes is the importance laid by the British Ministry of Defence and the commands of the fighting forces on defensive

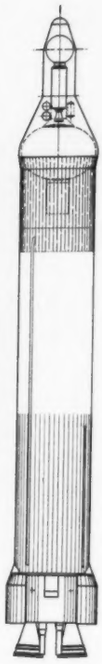
English Electric Aviation Ltd.'s 21-foot *Thunderbird* was demonstrated in Farnborough as a complete weapons system by troops of the 36th A. A. Regiment of the Royal Artillery.



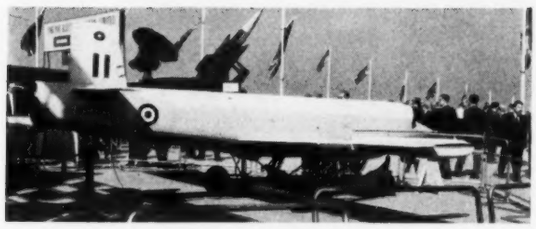
Armstrong Whitworth Aircraft, the Genera Electric Co. and Sperry Gyroscope showed the *Seaslug* ship-based anti-aircraft rocket and its most important systems on a common stand.







Left: the surprise of Farnborough — a 1:5 scale model of the British *Blue Streak* long range missile. *Right*: Drawing of a projected three-stage space vehicle comprising the *Blue Streak* LRBM, a modified *Black Knight* (with elliptical fuel tank), a solid fuel motor and satellite payload.



The *Jindivik 2B* radio remote-controlled target drone with Armstrong Siddeley *Viper ASV.8* jet engine. Originally developed by the Australian Government Factories, it is now being built and marketed by Fairey. Substantial quantity orders have been received from the British and Swedish Governments.

The *Malkara*, a wire-guided anti-aircraft missile with replaceable hollow-charge warhead weighing between 50 and 60 lb.

guided missiles, above all on land- and carrier-based anti-aircraft weapons systems. The stepping-up of the Bristol/Ferranti *Bloodhound* weapons system, the accelerated rate of preparation of the Armstrong Whitworth *Seaslug* and the English Electric *Thunderbird*, and the development of improved versions of these missiles, are conclusive proof of the new direction taken by British anti-aircraft defence. Nor should we forget the Short *Seacat*, shown for the first time at Farnborough on a stabilized quadruple launcher. This is a small and highly manœuvrable guided missile which the Royal Navy will be the first maritime force to use as replacement for the 40-mm Bofors anti-aircraft guns on its vessels. The trend initiated by the Americans with their *Hawk* rocket, namely the development of mobile short-range anti-aircraft weapons, is being logically followed up with the land-based version of the *Seacat*, designated *Tigercat*. Built by Short and Elliott Brothers as a private venture, the *Tigercat* will be particularly suitable for operation from armoured land vehicles.

In addition to a complete *Bloodhound* weapons system, including target illumination radar, a cutaway model of the *Bloodhound* was on display in the guided missile area in front of the exhibition tent, showing the arrangement of all internal systems and their operation. The beam-guided *Seaslug* was also on view, together with its most important sub-assemblies, including the General Electric Company's guidance receiver containing about 100 valves, the Sperry electronic computer and cruciform vane control system, and a Stardac analogue computer for ground testing and simulation of the guidance system carried by the missile. Also exhibited were a *Seaslug* rocket without booster, showing the precise configuration of fuselage and cruciform control surfaces and wings, and an operational weapon with four boosters on the tilting and revolving launching ramp which is to be standard equipment on the new guided missile frigates of the *County* class. Not long ago six target drones were destroyed at six test-firings by *Seaslugs* with live warheads; in more than one case the first of two weapons fired in a salvo hit the drone, while the second homed on the largest remaining piece of wreckage and shattered it.

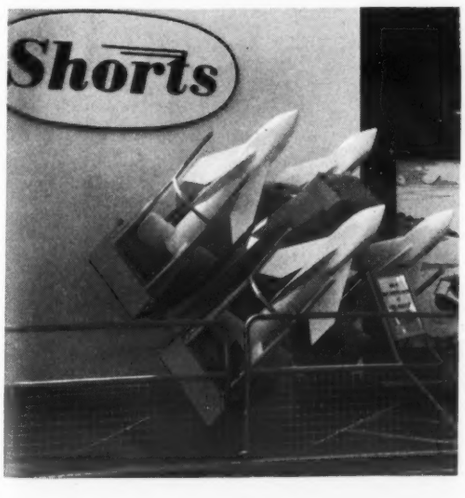
The English Electric *Thunderbird*, also demonstrated as a complete weapons system, is at present undergoing operational acceptance tests at Woomera and will then be allocated in limited numbers to special units of the British Army. A variant powered by a solid fuel rocket motor with high specific thrust and a longer range guidance system should be on view at the next SBAC Display, together with the improved *Bloodhound*.

After announcing the creation of a new, larger air-to-air missile for later versions of the P.1, de Havilland Propellers Ltd. explained for the first time the operation of the infra-red guidance system of its pneumatically controlled *Firestreak* air-to-air missile and exhibited the gimballed infra-red homing head with collector and seeker cell. Details of this rocket, of the *Bloodhound* and *Seaslug*, must be kept for a later issue.

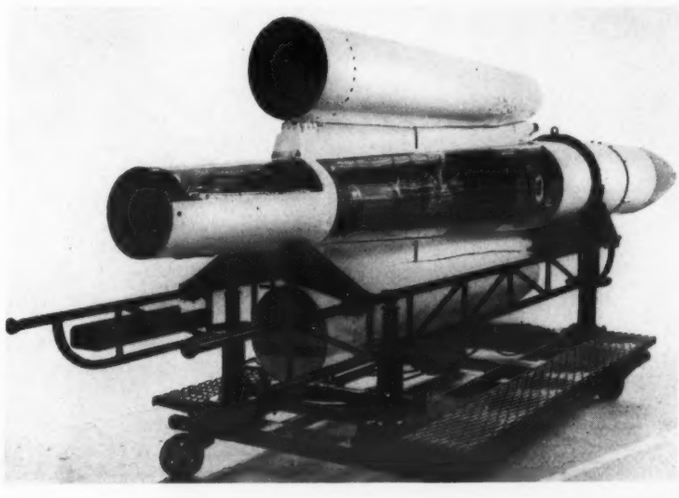
On the Ministry of Supply stand visitors could see the *Malkara* wire-guided missile, built in Australia and ordered by the Ministry in quantity. Designed for operations against tanks, small naval vessels and fixed emplacements over a 2-miles range, the 77" *Malkara* can be launched from armoured vehicles. Its hollow-charge warhead is said to be able to penetrate the toughest armour at present in existence. However, its weight of 208 lb (without launcher) precludes its use by the infantry. It is nevertheless significant that the Ministry of Supply has decided to purchase the *Malkara* in quantity, in view of the uncertain future of the Pye and Vickers anti-tank weapons.

*

The British guided missile programme, as manifested at this year's Farnborough Display, covers the entire range of weapons to be found in the American and Russian arsenals. Whether all the guided missiles projected will become operational in time to be of service, will depend on whether the aircraft industry can be converted to cope with these new tasks and keep to the programme once the latter has been fixed.



The Short *Seacat*, a new and highly promising anti-aircraft rocket for close-range operations against low-flying attackers, shown here on a quadruple launcher built to Royal Navy specifications.



A cutaway *Bloodhound* airframe gave for the first time a glimpse into the construction of the now operational Bristol/Ferranti anti-aircraft missile.

Book Reviews

Space Technology. — Edited by Howard S. Seifert. — John Willey & Sons, Inc., New York, and Chapman & Hall Ltd., London, 1959 (English; price $22.50).

This is a first and highly comprehensive collection of over 1,000 pages of analytically arranged monographs on the theme of space technology. No less than 38 American scientists, engineers and top men in industry have contributed technical treatises on every imaginable question relating to flight dynamics and ballistics, the construction of rocket engines and airframes, guidance, control and telemetering, not to mention the problems of space medicine. This magnificently edited survey is as far as we know the most complete work of reference on this new branch of science. A mere glance at the list of authors is sufficient introduction: A. J. Eggers, K. A. Ehricke, A. Kantrowitz, J. Kaplan, W. H. Pickering, S. Ramo, H. Strughold, M. Summerfield, J. A. Van Allen and others give a succinct résumé of their experiences in their fields of work. The book is abundantly illustrated, and its clarity is due to the fact that it springs from a series of lectures given by the authors at the University of California under the patronage of the Space Technology Laboratories Inc. Re.

The Aircraft Year Book. — Official publication of the Aerospace Industries Association (formerly Aircraft Industries Association). — American Aviation Publications, Inc., Washington, D.C., 1959 (English; 486 pages; price $6.00).

The new edition of this reference book on United States aviation records just about everything of aeronautical interest that took place during 1958 and provides information on the production programmes of the industries grouped under AIA. It also contains brief reports on the activities of the U.S. airlines, type descriptions of all the newer aircraft, engine and missile models, an outline of U.S. aviation history since 1784, a list of records and a survey of the trade papers published in the United States last year. Profusely illustrated; large format. Ri.

Deutsches Reichs-Adressbuch für Industrie, Gewerbe, Handel (with analytical key). Verlag Rudof Mosse, Munich, 1959 (German; 2,271 pages; cloth-bound; price DM 20.— incl. packing and postage).

For all those with any knowledge of German reference literature the name Rudolf Mosse is a household word. Well-printed, clearly set out, simply presented, this directory is invaluable for all who must keep in touch with German industry. The contents include a register of official organizations and manufacturers' associations; a classified list of about 70,000 categories of goods and services; an English/French/Spanish export-import register; and an analytical list with about 8,000 headings. He.

Guide du Fret Aérien. J. Berény. Paris, 1959 (French; 104 pages; price Ffr. 800).

There is no need to give a further detailed appreciation of this superlatively edited handbook of the French and international airfreight business, as *Interavia* has taken a keen interest in all earlier editions, which it has heartily recommended to readers. Airlines, airports, freight aircraft, freight volume, insurance, air law, all information which has anything to do with airfreight has been carefully compiled and presented in an easily accessible form. He.

Tourisme et Aviation Commerciale ; les Plages de France, by Monique Dacharry. Foreword by J. Boucoiran, Director General of Tourism. Blondel la Rougery, Paris, 1959 (French; 126 pages; 16 photographs, 10 maps and plans, 25 diagrams; price Ffr. 1,700.).

This little book deals with the most burning problem facing air transport today; how to fill aircraft by promoting holiday traffic and increasing the tourist volume. It is no mere chance that, out of 23 French cities with over 100,000 inhabitants, only 10 are served by scheduled flights, while a large number of holiday resorts suffer from congested flight schedules. Development, ground organization, the volume of scheduled and unscheduled traffic (passengers, cars, other freight etc.) at French holiday resorts, are subjected to a penetrating analysis which is of the greatest value, not only to the French, but to all those concerned in air transport. He.

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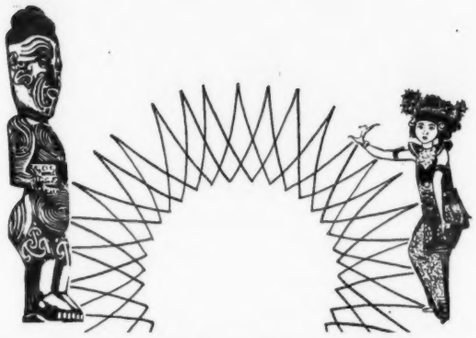

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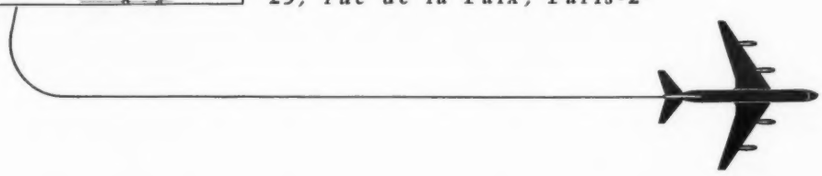

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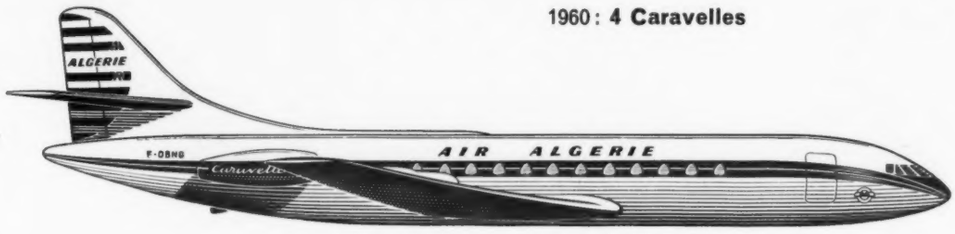

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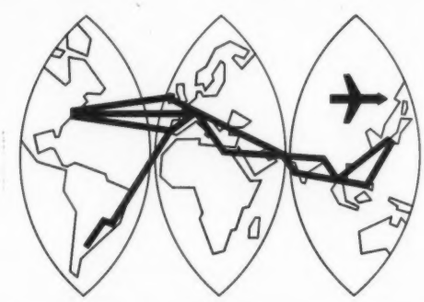

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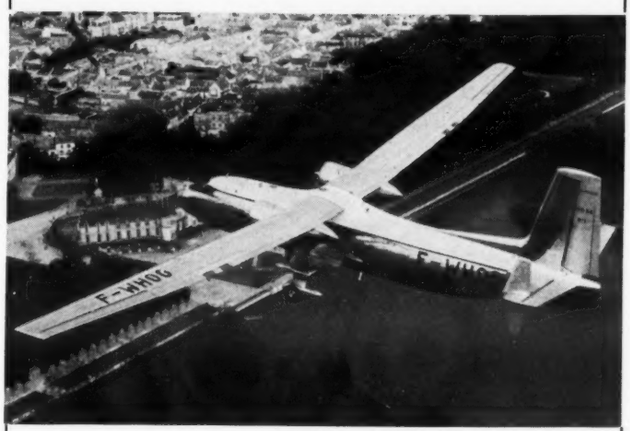

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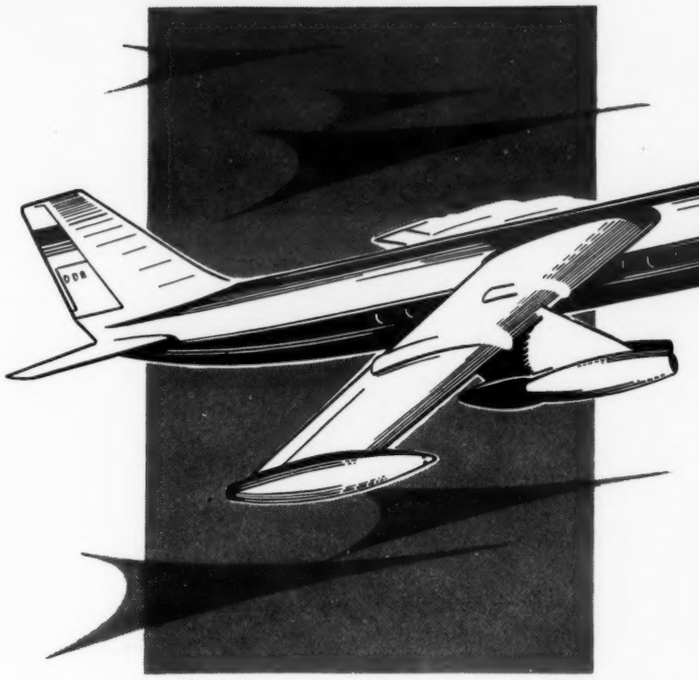

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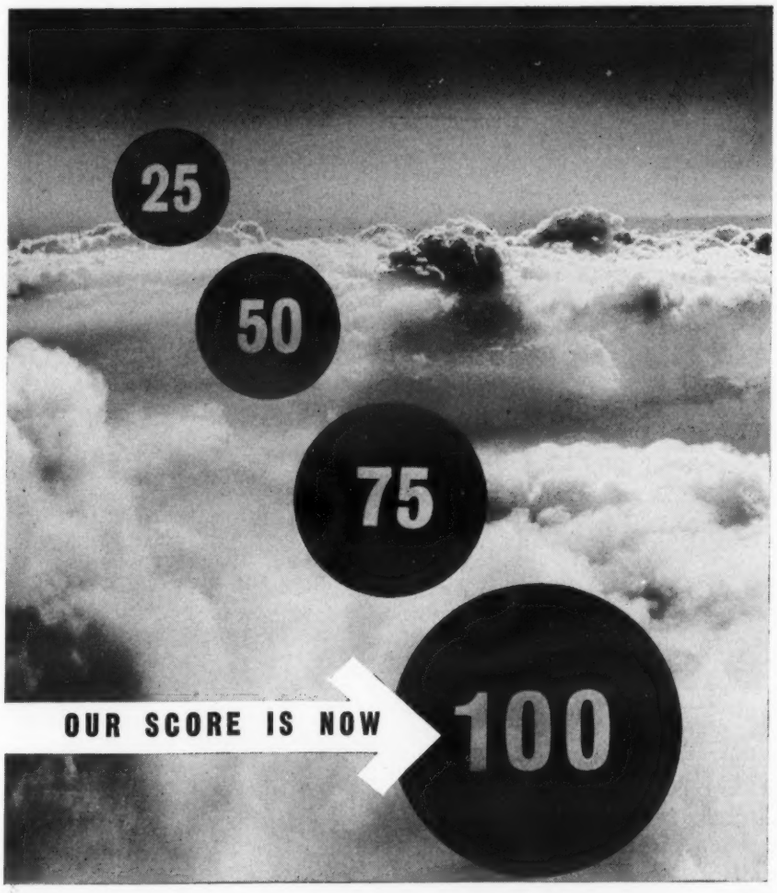

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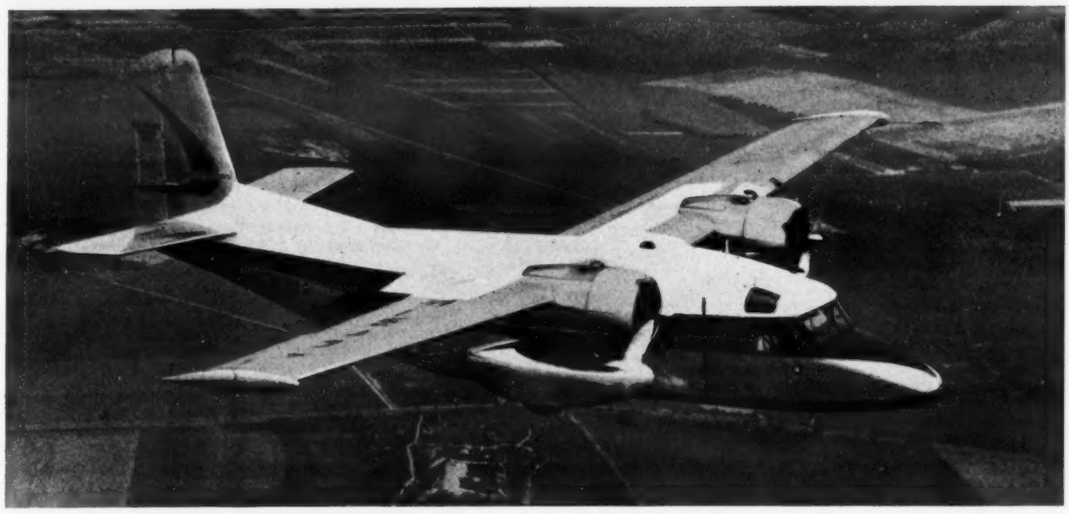

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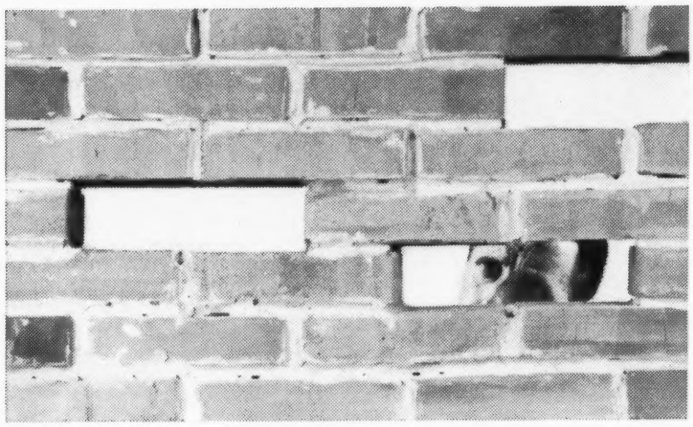

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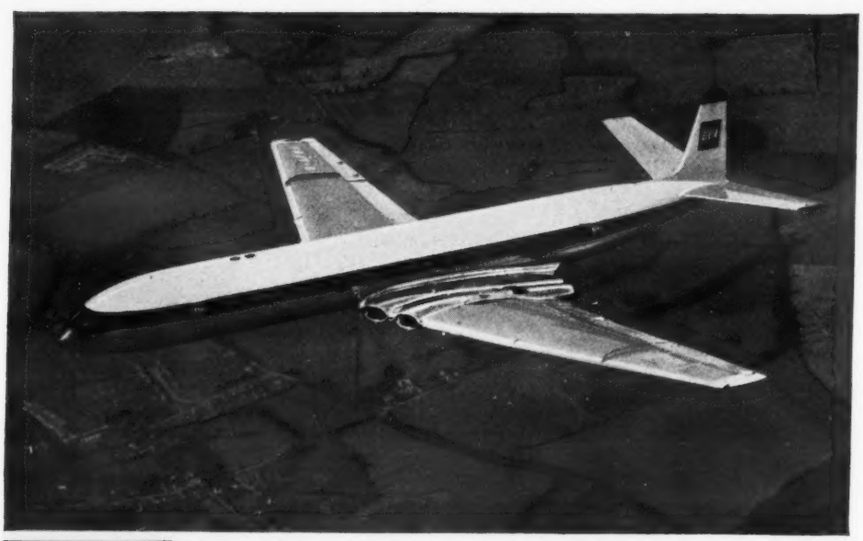

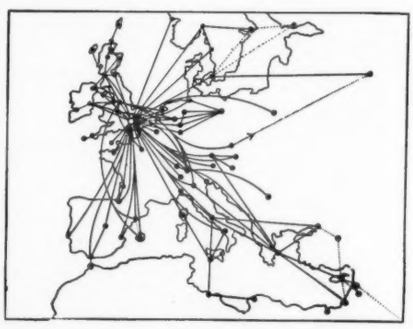

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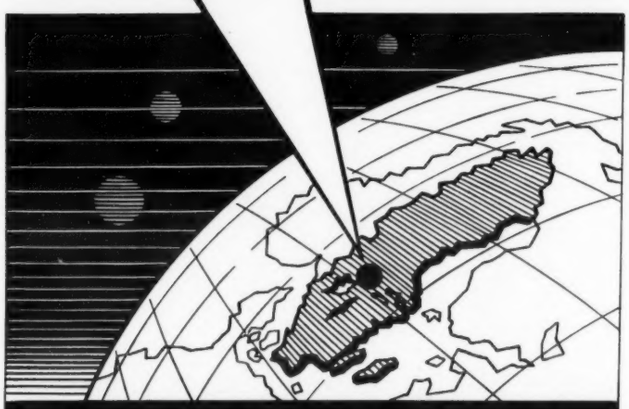

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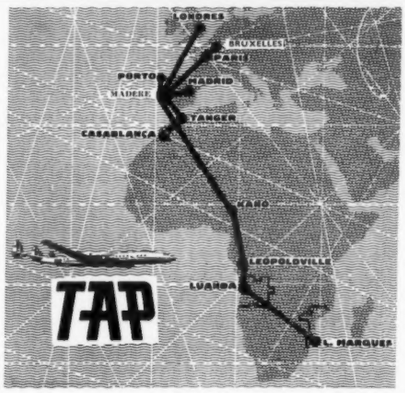

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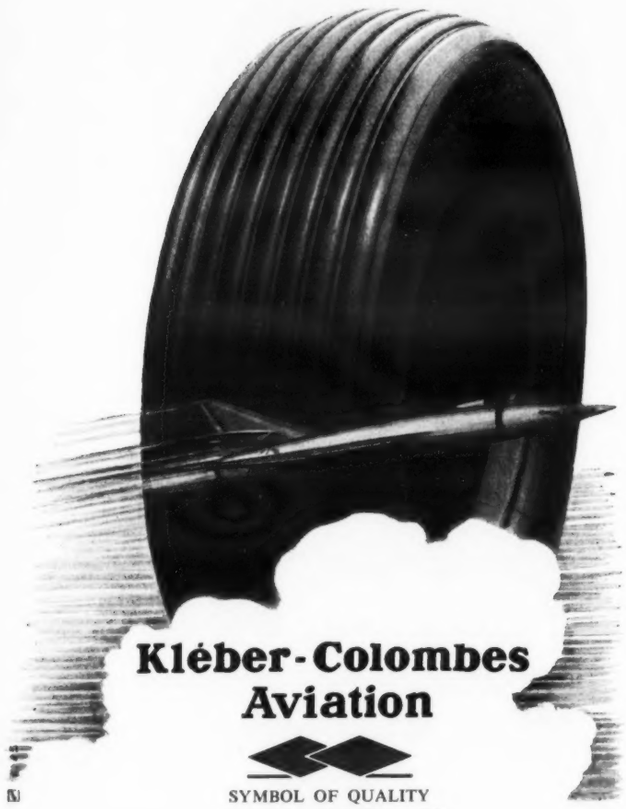

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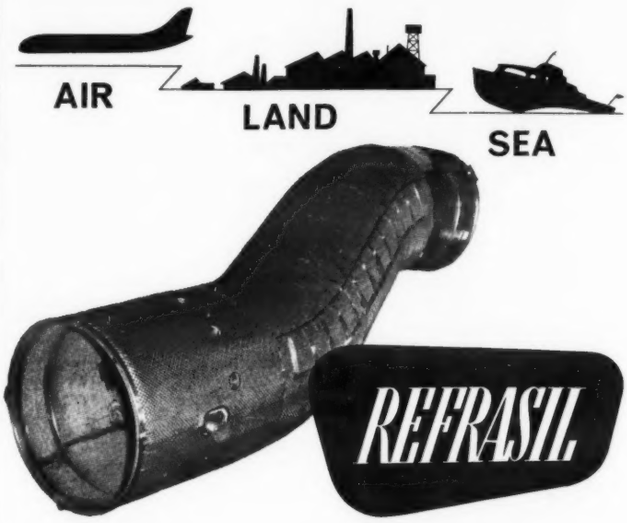

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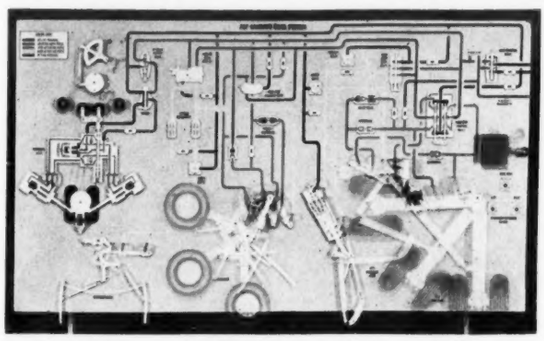

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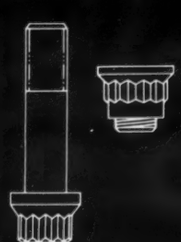

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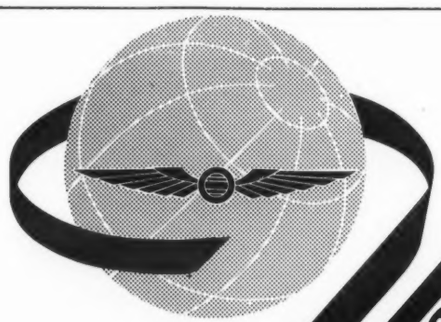

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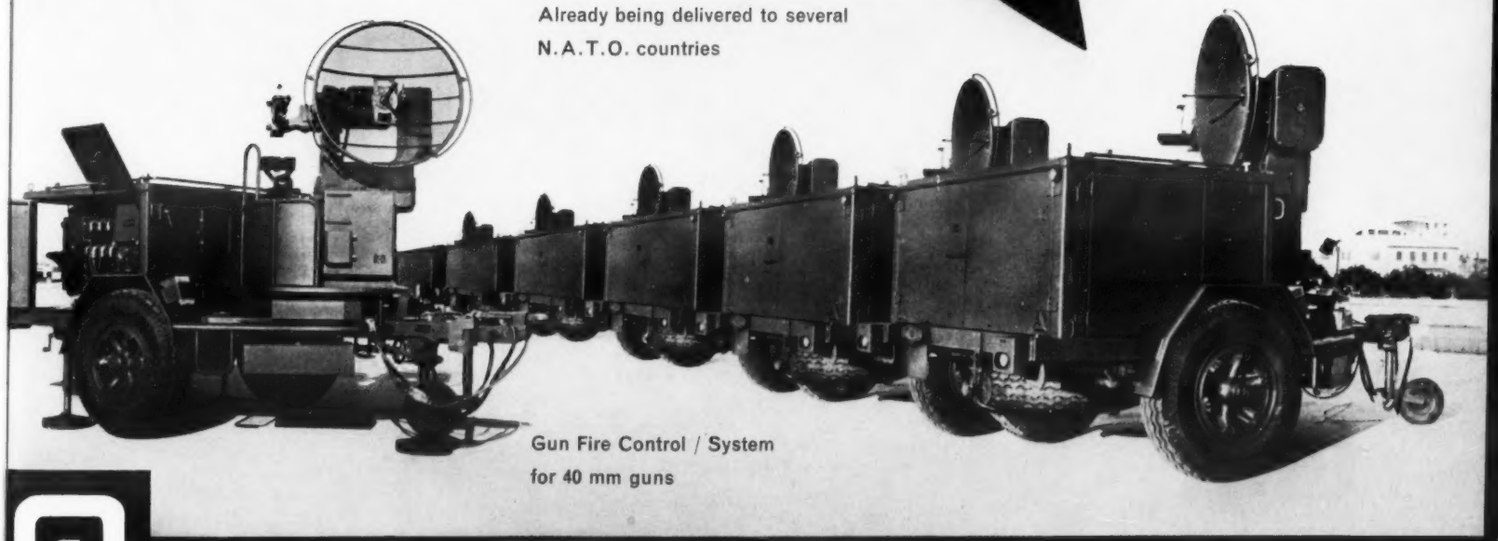

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